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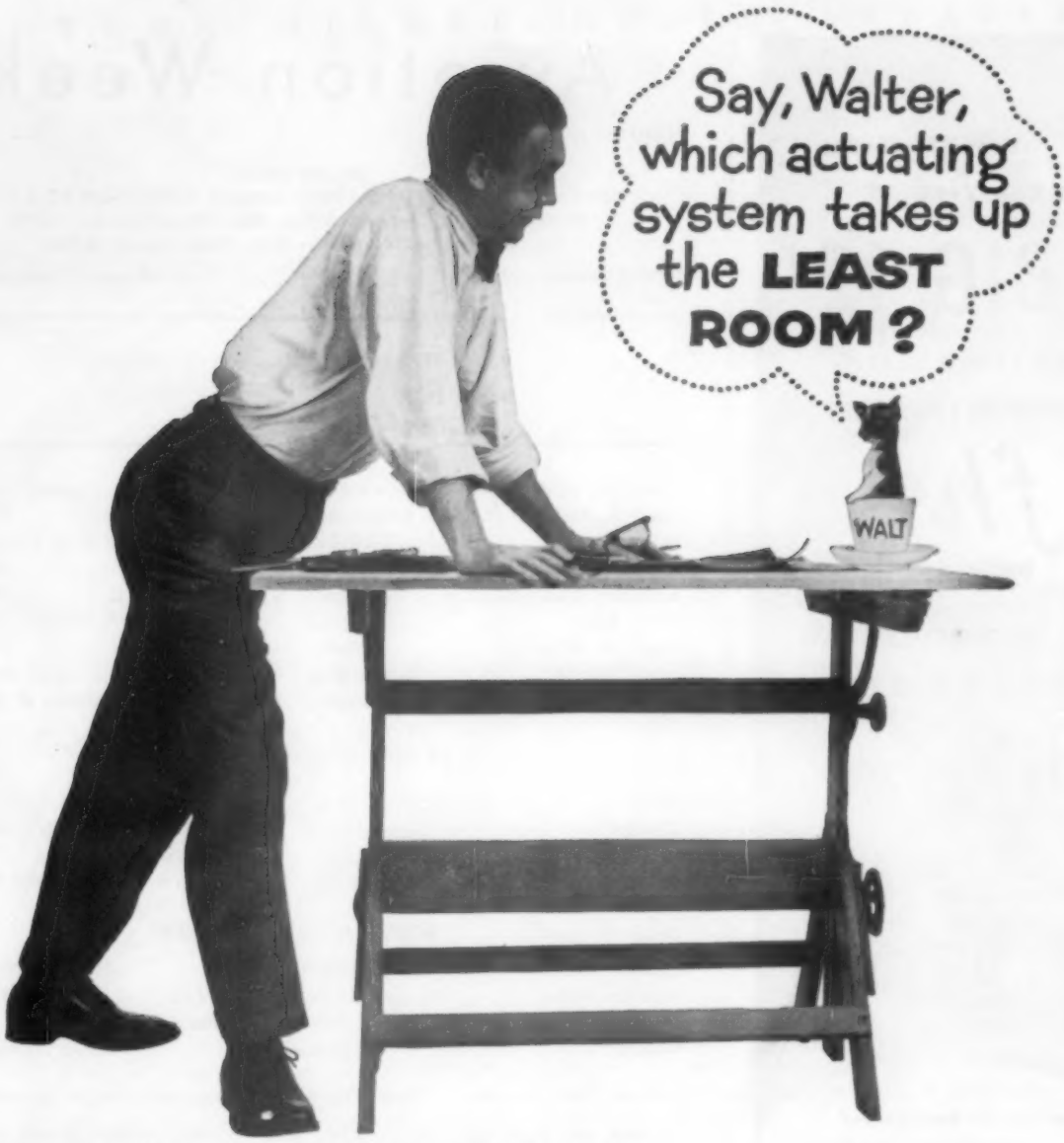

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Table of Contents on Page 8

54,928 copies of this issue printed

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ANOTHER MILESTONE IN AVIATION

THE EARLY BIRDS DEDICATE MONUMENT HONORING PIONEER GOVERNORS ISLAND FLIERS

THIS HANDSOME MONUMENT was unveiled last December 17th on Governors Island, New York, in honor of the American pioneer aviators who contributed so much to the development of aviation by their early flights to and from this historic Island. The monument was unveiled by helicopter—another aviation "first."

The monument was erected under the auspices of The Early Birds, an organization of those who flew solo before December 17, 1916 . . . 38 years, to the day, before the unveiling of the monument.

The propeller on the monument was cast in bronze, directly from one of the Wright Brothers' wooden propellers, two of which propelled the first U. S. Army military plane, a 1909 Wright. (This famous plane is shown in phantom illustration, above.)

The monument weighs more than 15 tons, and is hewn out of Deer Creek granite from Maine, specially quarried for this project. It faces the largest structure on Governors Island, Building 100; and will command the attention of thousands of visitors every year.

* * *

PHILLIPS PETROLEUM COMPANY takes this opportunity to join in paying tribute to the memory of those distinguished Governors Island pioneers, living and dead, who contributed so significantly to the advancement of American aviation. And Phillips is also honored to pay tribute to The Early Birds, who have so signally commemorated the accomplishments of their flying colleagues.

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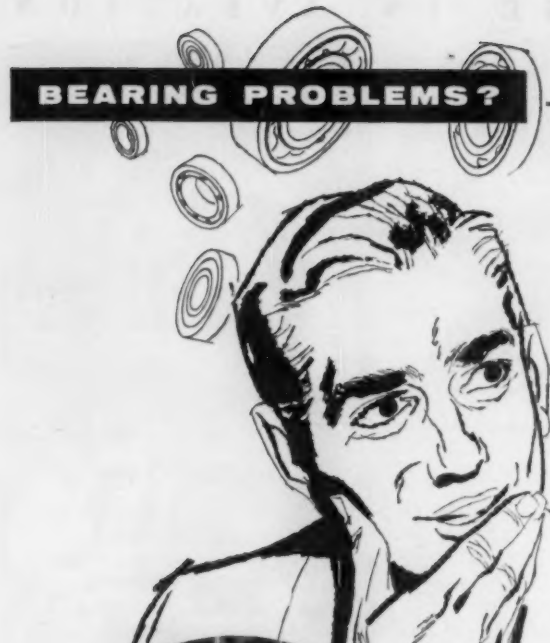

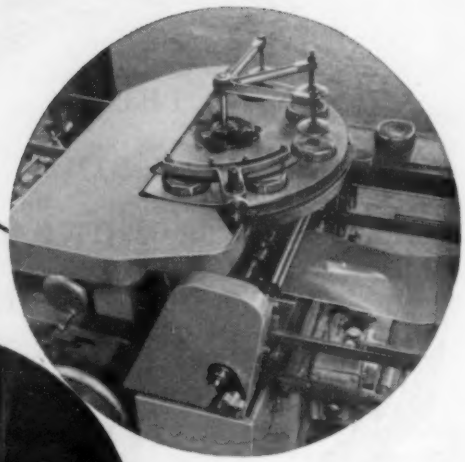

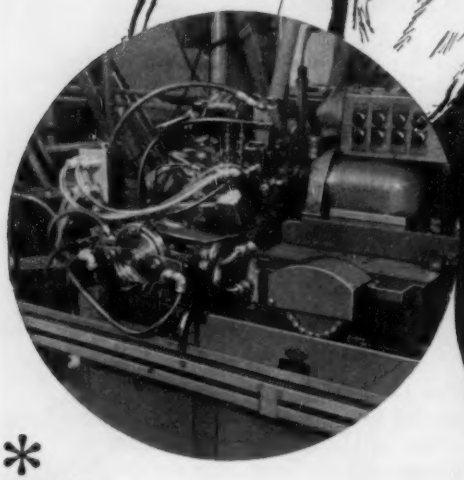

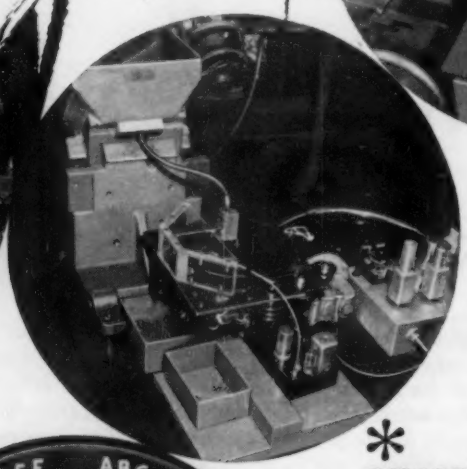

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BALL BEARINGS

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NEWS DIGEST

Domestic

First flight tests of Ryan Aeronautical Co.'s jet-powered vertical-takeoff fighter are expected to start early this spring. The Rolls-Royce Avon engine that will power the Air Force VTO project now is being inspected at Ryan's San Diego plant prior to installation in the airframe.

U. S. Court of Appeals last week ordered the federal government to pay $15,000 to each estate of two persons killed in 1949 when an Eastern Air Lines DC-3 and a Bolivian P-38 collided over Washington National Airport. The ruling said the airport tower, which cleared EAL's transport and the P-38 to land at the same time, was negligent in the crash that killed a total of 55. The court also ordered a new trial on whether Eastern must share the blame.

Wright J65 turbojets completed 700 hours of air time in 29 days during flight tests of six North American FJ-3s at Naval Air Station, Patuxent River, Md. Curtiss-Wright Corp. claims the hours set a new record for accelerated flight testing.

Civil Aeronautics Board has decided that Sherman M. Fairchild no longer can serve as director of both Pan American World Airways and Fairchild Engine & Airplane Corp. Previous CAB approval of the interlocking relationship expired last October. Now the Board finds that Fairchild's Fokker F-27 is close to flight test and, since FAA is a potential customer for the transport, "it is difficult to see how . . . Fairchild can avoid being in a position of conflicting interests. . . ."

First commercial heliport in New York City, reported by newspapers to be well on the way to becoming a reality, has been stymied temporarily in a web of political red tape.

Financial

North American Aviation, Inc., Los Angeles, reports a net profit of $5,950,000 for the quarter ended Dec. 31, dropping sharply from $7,654,736 for the preceding three months but more than doubling the $2,780,000 for the same period of 1953. The decline reflected decreased deliveries of F-100 Super Sabres to USAF. Sales and other income totaled $177,493,327, compared with $118,167,560 for the last quarter of 1953. Backlog Jan. 1: $1,156,611,036, slightly below $1,174 million Oct. 1.

Wingtip Jets Provide Power Safety Margin

Additional 2,000 lb. total thrust provided by small Fairchild J44 turbojets installed on wingtips of Fairchild C-123B give the plane climb rate of 500 fpm. after feathering one prop during takeoff, compared with 150-fpm. climb using only piston engine. Modified C-123B is pictured performing with left prop feathered during recent demonstrations before USAF's Air Development & Research Command and Air Materiel Command at Hagerstown, Md. Experimental jet augmentation studies are part of a Fairchild private research project. Firm also has programmed tests to obtain military and CAA certification of the J44, primarily a missile powerplant, for inhabited aircraft. To cut drag when not in use, J44s have doors that seal off inlets.

Braniff Airways will redeem all outstanding Mid-Continent Airlines' 12-year 4½% convertible debentures Mar. 7. Braniff assumed responsibility for the issue when it merged with Mid-Continent in August 1952. Approximately $1,950,000 of the debentures are outstanding, will be redeemed at 103% of the principal plus interest.

Lake Central Airlines had a net profit of $8,863 for 1954, its first 12-month period in the black. In 1953, LCA reported a net loss of $176,997. Operating profit for last year totaled $31,285.

Lockheed Aircraft Corp., Burbank, Calif., will pay a 60-cent dividend on capital stock Mar. 11 to shareholders of record Feb. 18.

Western Air Lines has declared regular and extra dividends totaling 30 cents a share, payable Mar. 15 to holders of record Mar. 2.

International

Canada's defense expenditures will total $1,775 million during fiscal 1955-56, according to estimates submitted to Parliament. This is a drop of $133 million from the current year that will end Mar. 31. Aircraft and engines will take the largest cut of $102 million.

Hawker Hunter, the only modern British jet fighter now going into squadron service, still suffers from oxygen starvation when its four Aden cannon are fired. But the House of Commons has been assured this problem is being solved.

Vickers Viscounts probably will begin scheduled service Mar. 28 on Trans-Canada Air Lines' Montreal-Toronto-Winnipeg route. TCA's new turboprop transports are expected to start Toronto-New York flights Apr. 4.

KLM Royal Dutch Airlines has ordered Bendix storm-warning radar for its four new Lockheed Super Constellations, expects to take delivery on the new units in February 1956. The order makes KLM the first European airline to buy American radar.

First production Beverley C.Mk. 1, Blackburn General & Aircraft's 60-ton-gross military transport, has made its maiden flight. The British company reports assembly of Beverleys for the Royal Air Force is ahead of schedule.

Indian Airlines DC-3 crashed Feb. 2 near Nagpur in Central India. All 10 persons aboard were killed.

West Germany's Lufthansa is negotiating with Lockheed Aircraft Corp. for four more Super Constellations for its trans-Atlantic fleet. Four Super Connies now on order will be delivered to the airline next month.

Philippine Air Lines has purchased three single-engine Otters from de Havilland Aircraft of Canada, plans to use the planes as 11-place passenger transports.

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The Aviation Week

February 14, 1955

Headline News

Ike Sets Pacific Air Route Pattern.... 12
Sonic Tests Dictate F-100 Changes.... 13
Navaid Decision: Get Tacan Ready.. 16
EAL Colonial Merger Taking Shape.. 16
Why Small Firms Lose AF Orders.... 21

Aeronautical Engineering

How the Comet Mystery Was Solved... 26
IAS Summaries 40

Production

Magnesium Castings Aid in Missiles... 55

Avionics

Radar Beacons to Speed Traffic Flow.. 70
AMC Turns to More-Reliable Tubes.. 76

Equipment

AF Buys New Temperature Alarm.... 87

Financial

Stock Splits Mark Strong Market..... 101

Air Transport

Air Route Radar to Tackle Traffic Snarl 107
EAL 1956 Goal: 5 Billion Seat-Miles.. 108
CAB Nominee Gets Democratic Support 110
New Hope for Rails in Mail Case..... 110
Airlines Scrap for Mexico Nonstop.... 112
Autopilots Cut American DC-7 Costs.. 114

Editorial

Twin Spotlights on Naval Aviation.. 122

Departments

News Digest 7
Picture Page 9
Who's Where 11
Industry Observer 11
Aviation Calendar 24
What's New 46
Letters 50
Tax Writeoffs 60
USAF Contracts 60
Navy Contracts 68
ARDC Contracts 68
Filter Center 82
Off the Line..... 90
New Aviation Products..... 92
Also on the Market..... 98
CAB Orders 115
Editorial 122

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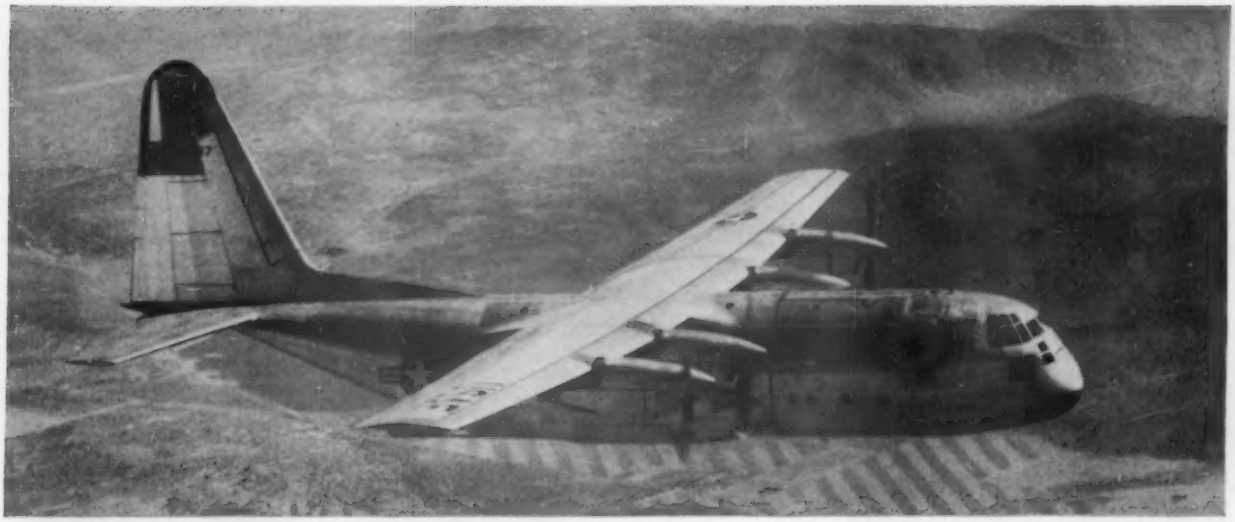
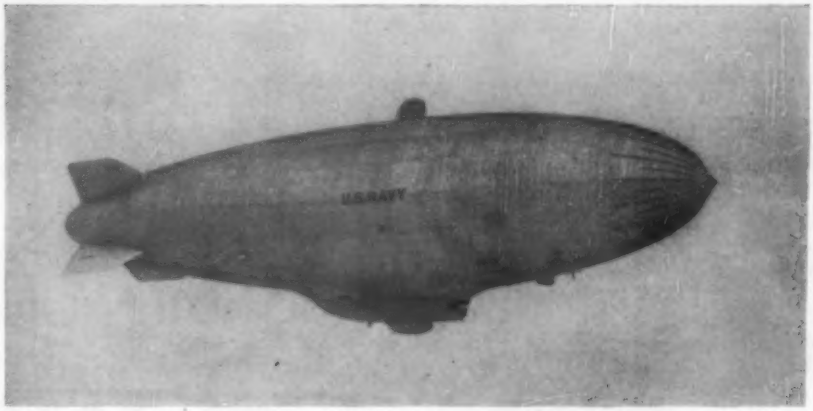


LOCKHEED YC-130 HERCULES, powered by four Allison YT56-A-1 turboprops, flies over California in course of intensive test program in which another YC-130 also is participating. Production C-130As are taking shape for Air Force at Lockheed's Marietta, Ga., facility.

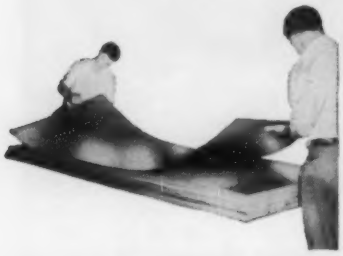
New Aircraft Undergo Tests



GOODYEAR ZPG-2W, new Navy early warning radar picket blimp, features radomes atop helium-filled envelope, also under the cabin and beneath the envelope ahead of the cabin. Navy's new blimp is 342 ft. long.

COLONIAL SC-1 SKIMMER is new three-place business amphibian nearing completion of tests. Production Skimmers will come out of Colonial Aircraft Corp.'s Long Island, N. Y., plant late this year. Price will be under $16,000. Pusher powerplant is 135-hp. Lycoming.

Rem-Cru titanium is used extensively in such advanced production aircraft as the new North American F-100 Super Sabre and the eight-jet Boeing B-52 Stratofortress.



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WHO'S WHERE

In the Front Office

Jack Frye, former president of Trans World Airlines, has resigned effective Apr. 1 as president and a director of General Aniline & Film Corp., New York, to re-enter the aviation industry in an unannounced capacity. **John H. Hilldring**, executive vice president of the corporation, will succeed Frye as president.

Gerald Morisset has become a member of Canada's three-man Air Transport Board, succeeding the late **J. P. R. Vachon**.

Gustave J. Koehler has retired as president of Koehler Aircraft Products Co., but will continue with the Dayton firm as an advisor. **R. T. Frisbie**, senior chairman of the New Britain Machine Co.'s executive committee, will succeed Koehler as presipresident. **Richard M. Johnson** will become vice president-general manager.

Arthur D. Lewis, assistant vice president of American Airlines, has been named executive vice president of Hawaiian Airlines to succeed **Ford Studebaker**, who resigned.

Walter J. Curley is new director of the Shipbuilding, Railroad and Aircraft Division, Business and Defense Services Administration, Department of Commerce.

G. W. Hall has been appointed assistant managing director of Fairey Aviation Co., London, will be in charge of executive and administrative organization. **L. Massey Hilton**, also assistant managing director, is taking over group organization and policy plus sales and liaison.

William Davey has been elected vice president-manufacturing of Piasecki Helicopter Corp., Morton, Pa.

Robert C. Williams, former purchasing agent of Kaman Aircraft Corp., has joined Precision Gears & Products, Inc., Paterson, N. J., as vice president and contracts director.

John M. Erskine is new vice president of Atlantic Aviation Corp., Teterboro, N. J., taking over New England Division.

F. D. Walker has resigned as editorial director of Skyways and Skyways Airport Service director.

John K. Northrop, founder and former president of Northrop Aircraft, Inc., has been elected to the board of directors of Garrett Corp., Los Angeles.

Changes

Dr. Richard W. Porter, who has been general manager of General Electric's guided missile department, is new consultant on communication and control in GE's Engineering Services Division, New York.

Jacques F. Berrier is new director of International Civil Aviation Organization's Bureau of Administration and Services, Montreal.

Honors and Elections

Earl D. Johnson, president of Air Transport Assn., will be honored Feb. 19 by the University of Denver School of Aeronautics and the DU chapter of the International Aviation Fraternity at its eighth annual banquet in Denver's Albany Hotel.

INDUSTRY OBSERVER

► Some aerodynamicists speculate that North American may not have had the stability problems with the F-100 if the original vertical tail had been retained on production airplanes. The YF-100 had a tall vertical surface, later reduced by about one-third on the production F-100A. New tail, redesigned to delay the stability difficulties to a higher Mach number, is very much like the original surface.

► **Lockheed-Marietta's first production C-130 Hercules turboprop transport for the United States Air Force is expected to be rolled out early in April, about four months ahead of schedule. First power package on initial plane was hung in 19 min.**

► Bell Aircraft's VTO jet-powered vehicle (AVIATION WEEK Feb. 7, p. 16) is currently limited to cold-weather flights. Thrust loss with increased temperature is enough to reduce total engine output below the gross weight of the aircraft.

► **Advent of larger transports for use by the Troop Carrier Command will not result in wide scattering of soldiers along the drop zone. Air Force is confident that the speed of exit can be increased so that more paratroopers can be dropped in the same 10-to-30 sec. period needed to empty the Fairchild C-119.**

► Low noise level of Bristol Britannia is made possible largely by slow-rotating de Havilland props. Takeoff rpm. is slightly more than 1,000; normal cruise figure is 850 rpm., but the Britannia has been cruised at rates as low as 650 rpm. Maximum efficiency of the low-speed props is 84%.

► **Convair's XB-58 Hustler is incorporating about 1,000-1,200 sq. ft of stainless steel, all-metal sandwich structure (honeycomb core brazed to skin). This construction will be in portions of the wing and aft section of the fuselage in the vicinity of the hot zone of the powerplant.**

► Flight research program of the National Advisory Committee for Aeronautics with the Bell X-5 variable-sweep airplane is near completion. Plane will be kept on the active roster for pilot checkout in the handling characteristics of highly swept aircraft.

► **Modification of de Havilland Comet 2 airframes, rising out of the criticisms voiced during the accident investigation that followed losses of two Comet 1s early last year, will result in a net performance gain over the company's original figures. Complete rebuilding of the fuselage with heavier skin, added to other modifications, increases the gross weight by 1,150 lb.; detailed redesign saves 550 lb. for a net increase of 600 lb. Avon development by Rolls-Royce has increased engine takeoff rating to 7,350 lb., and reduced fuel consumption.**

► Bristol's answer to claims of lower specific weight of the single-spool turboprop at sea level takeoff power is to point out that at cruising altitude specific weight of its 3,000-lb. twin-spool B. E. 25 is less than either the Rolls-Royce R. B. 109 or the Napier Eland.

► **NACA psychologists had an important role in solving some very tricky problems that had the group's mathematicians stumped. Statistical techniques used by psychologists are able to handle problems that usual mathematics can't touch.**

► Vickers-Armstrongs is checking British engine manufacturers to see if there is an engine that will do a better job in its V-1000 transport than the Rolls-Royce Conway.

► **Two carrier versions of the Fouga Magister twin-jet trainer are under construction for the French Navy. The planes will incorporate carrier deck arresting gear and catapult fittings.**

and Rep. Walter Judd to meet with the

can use it for nonstop service when

beyond Calcutta to Tokyo to hook up

AVIATION WEEK VOL. 62, NO. 7
FEBRUARY 14, 1955

Eisenhower Sets Pacific Air Route Pattern

- **President settles status of PAA and Northwest.**
- **Pan American's Great Circle bid is deferred.**

By Craig Lewis

Decisions in two long-awaited international cases that set the air route pattern for U. S. airlines in the Pacific area have been issued by President Eisenhower. They break the log-jam of major international cases that have languished since the Administration took over and have prime economic significance to the industry.

Instructions to Civil Aeronautics Board in the trans-Pacific and West Coast-Hawaii cases settle the status of Northwest Airlines and Pan American World Airways in trans-Pacific service, at least temporarily.

Eisenhower told CAB he wanted:

- Renewal of Northwest's trans-Pacific route for seven years.
- Renewal of Pan American's Hawaii-Tokyo-Hong Kong route for five years and Hong Kong-India for three years.
- Deferral of a decision on PAA's application for a Great Circle route to Tokyo.
- Denial of Trans World Airlines' application for extension to Tokyo from India.
- Deferral of a decision on previously authorized points now in Communist hands.
- Elimination of Minneapolis/St. Paul as a gateway to the Orient.
- Denial of Transocean Airlines' application for a trans-Pacific route.
- Renewal of Northwest and Pan American between Seattle/Portland and Hawaii.
- Permanent certification of United Air Lines' Los Angeles/San Francisco-to-Hawaii route and denial of Transocean for a new route.

The renewal of Northwest to Hawaii was not in the President's original decision, but he subsequently changed his mind and decided to give both Pan Am and NWA the route for three years instead of the original designation of Pan American alone for five years.

Eisenhower told newsmen he changed the order because he had made a mistake and tried to correct it. The President said he is charged by Congress with cutting air subsidies and that he must examine unprofitable competition very closely to avoid a greater deficit, while striving to preserve competition in accordance with the American system.

Eisenhower said it looked as if one airline should be eliminated from the Hawaiian run, and he decided to go along with the line that had the greatest traffic and the smallest subsidy last year. He said subsequent information supplied by acting CAB chairman Chan Gurney indicated that competition could be preserved and still retain progress in eliminating subsidy.

▶ **Time Lag**—The change came as the result of this series of events:

THYE: A question of fair competition.

First, CAB published a letter from President Eisenhower that contained his instructions on the two cases. The President reviews all Board decisions concerning international routes. Usually he sends his instructions back to CAB privately, and the Board publishes the final order.

But this time, apparently to avoid the usual news leaks and rumors, the White House decided to release the President's letter when it was sent to CAB. It contained instructions to the Board to prepare final orders, making clear that Eisenhower had not signed them. This time lag gave interested parties a chance to act before the decision was made final.

▶ **Protests**—Northwest did not like the idea of losing the Seattle/Portland-Hawaii route. Protests poured into Washington from the North Central States and the Pacific Northwest—the area in which NWA is the dominant air carrier.

Congressional delegations from that area raised strong objections. Sen. Wayne Morse (Ind.-Ore.) said the decision "involves another regrettable example of this Administration's concern on behalf of big business." Telegrams and letters went to the White House from various state delegations pointing out that CAB had voted 5-0 in favor of Northwest and that NWA had offered to fly the route without subsidy.

The Minnesota delegation immediately made an appointment at the White House. Then the Administration pulled a switch and called Minnesota Republicans Sen. Edward J. Thye

White House Fumbles Route Decisions

White House handling of the trans-Pacific and West Coast-Hawaii cases caused consternation in both government and industry circles.

Civil Aeronautics Board is reported unhappy about the precedent-setting release of the President's letter before the orders were signed and final. There apparently was a complete lack of liaison between the White House and the Board while the President was deciding the case. Chairman Chan Gurney's late invitation to the White House appears to be the first time the President contacted the Board concerning the case.

Release of the decision before the orders were final is viewed by most observers as an unfortunate precedent. Whether or not the President was right in changing his mind, his action indicated that the right kind of political pressure can be effective in swinging the balance in air route decisions.

Some observers feel that the decisions reflect the limited competition concept of the Administration's civil air policy, the responsibility for which is attributed to Commerce Secretary Sinclair Weeks and Robert B. Murray, Jr., former Undersecretary for Transportation, who still is with the Department as a consultant. Weeks was deeply involved in the behind-the-scenes political struggle over the Pacific cases.

long slim fuselages required for low drag in supersonic aircraft, secondary [illegible]

personnel from the Flight Safety Direc-

and Rep. Walter Judd to meet with the President and acting CAB chairman Gurney, thus giving the initiative back to the Republicans.

▶ **New Orders**—After the White House meeting, Thye said the President would modify his decision on Northwest in light of additional information presented to him.

Eisenhower then sent another letter to CAB chairman Gurney directing certification of both Northwest and PAA on the Seattle/Portland to Hawaii route for three years. He said: "Since my original action in this case I have received from you information to the effect that within two years all airline subsidies in the Pacific area will probably have been eliminated or will at least approach that point."

Thye told AVIATION WEEK he was very much gratified that the President had changed his order and that he felt the President was impressed by the facts presented to him on NWA.

"While Northwest Airlines is an extremely important enterprise to my own state and the upper Midwest and Northwest," said Thye, "I was as much concerned in the question of fair competition and in the presentation of the actual facts as to operation, costs and subsidies for the President's information as I was in presenting the case for Northwest Airlines when it was confronted with an adverse decision."

▶ **No Major Change**—Under the terms of the President's decision, the present Pacific route pattern will remain largely unchanged. The order is perhaps more significant for what it did not do than for what it did.

Northwest had asked for permanent certification on its North Pacific route. Eisenhower decided against this and approved extension of the Seattle/Portland-Anchorage-Tokyo route for seven years, the routes beyond Tokyo to Okinawa, Formosa, Hong Kong and the Philippines for five years and the Korea route for three years.

The President said he thinks considerations of national interest require continuation of two American-flag airlines across the Pacific.

"However," he said, "I believe that permanent certification of Northwest Airlines is premature as long as subsidy payments are necessary for its operations. A temporary certificate will provide the carrier with the opportunity to demonstrate its ability to operate without subsidies within a reasonable period of time and will give the government the opporunity to review the matter when the certificate expires."

▶ **PAA Nonstop Plan**—A crucial point in the case was Pan American's bid for the Great Circle route. PAA wants restrictions removed that call for a mid-Pacific stop so it can operate the short route in competition with NWA and can use it for nonstop service when Douglas Aircraft Co. delivers its DC-7s.

The President deferred action on this question. Northwest wants to keep Pan Am off the Great Circle route as much as PAA wants on, and both sides can be expected to conduct powerful campaigns.

The President put off a decision "pending further study and later reports on the economic and technical feasibility and the military and foreign policy implications of nonstop service between the West Coast and the Orient."

The denial of TWA's application for an extension to Tokyo knocks out plans for a second round-the-world U.S.-flag service. TWA wanted to be certificated beyond Calcutta to Tokyo to hook up with Northwest and provide a competing service with the Pan American round-the-world service which was authorized in 1946.

▶ **Extension Denied**—NWA took a slightly different view and asked to be extended beyond Tokyo to Calcutta to meet TWA in India, but either application would have the same result. Eisenhower decided against such a plan.

Transocean's applications for certification as a trans-Pacific carrier were denied.

Northwest's authority to use the twin cities as a U.S. gateway on its Orient route was withdrawn. The question of local service between the Twin Cities and Anchorage remains to be settled in the States-Alaska case.

Sonic Tests Dictate F-100 Changes

Findings reveal aerodynamic phenomena that will be considered in designing all new supersonic aircraft.

Major exploration of the frontiers of supersonic flight by pilots of the Air Force, North American Aviation, Inc., and the National Advisory Committee for Aeronautics preceded the ungrounding of the F-100 Super Sabre fighter this month (AVIATION WEEK Feb. 7, p. 7).

Modifications dictated by this flight test program to restore the F-100 to flight duty with USAF included:

- **Increase tail area** by 27%.
- **Increase wing span** by one foot at each tip, making a total of 38 ft.
- **Minor changes** in lateral and longitudinal controls systems to improve pilot feel.

Three aircraft incorporating the modifications have been used for intensive flight testing at Edwards AFB by North American chief test pilot Bob Baker, NACA pilots, and USAF pilots including: Maj. Gen. Al Boyd, commander, Wright Air Development Center; Brig. Gen. Stanley Holtoner, commander, USAF Flight Test Center; and Lt. Col. Frank K. Everest, who set the present world speed record of 755.149 mph. in the F-100 more than a year before its grounding last Nov. 11.

What was wrong with the F-100?

▶ **Heavily Instrumented**—For almost three months USAF's first operational supersonic fighter sat idle on flight lines while engineers probed into three crashes of the Super Sabre looking for the answer to this question.

Most important of the accidents to those seeking the solution was the one which took the life of North American's chief engineering test pilot, George Welch, last Oct. 12. Welch's plane was a heavily instrumented test aircraft. Many of the instruments were recovered.

The findings reveal aerodynamic phenomena of the highest importance to the aircraft industry that will be considered in the design of all supersonic aircraft. It is a condition likely to exist in the subsonic speed ranges of all supersonic aircraft and is independent of wing planform.

▶ **Reason for Yaw**—It was not a question of stability. The F-100 has static stability. Another element is added when the aircraft is maneuvered violently from forces due to rotating masses. The intentional roll of an aircraft like the F-100, with its weight distributed along a long cigar-like fuselage, causes the aircraft pitch and yaw. The tail restrains this. There is no trouble until these forces exceed the power of the vertical tail to restore the aircraft. That is the point at which it goes violently out of control.

The high yaw of the F-100 under rolling conditions was the result of the coupling of the principal moments of inertia. This essentially is a transfer of energy from the roll axis to yaw axis or pitch axis and back again in a series of fluctuations. The result is violent and wild gyrations of the aircraft which the pilot is unable to control. This transfer of energy results in forces along an axis greater than the forces anticipated in the design of the aircraft.

▶ **Old and New**—This is not entirely a new principle. It is new in the sense that these phenomena have been observed in flight. It is old in the sense that it has been theoretically possible, but it has never been important before.

With the low aspect ratio wings and

long slim fuselages required for low drag in supersonic aircraft, secondary terms in the design equations, formerly of little importance in the design of slower aircraft with high aspect ratio wings, have now become increasingly important.

This requires much more detailed calculation in the design of aircraft. Coupling terms must be included in the calculations in detail.

▶ **Weight Distribution**—A Reeves Electric Analog Computer (REAC) was used in studying the appearance of these phenomena and found that its revised configuration for the F-100 checked out very well.

The major fix is the time-honored custom of increasing the size of the vertical stabilizer. This area has been increased by 27% in the Super Sabre modification.

These "new" forces have nothing to do with the planform of the wing. It is a question of distribution of weight in the aircraft. They are not a function of the G-loading of the airplane but of the angle of attack.

Only as the G-loading affects the attitude of the aircraft is it important. There are critical load factors where these forces are more likely to be encountered.

The maximum violence occurs at a relatively low load factor of from 1G to 3Gs for the F-100.

▶ **Subsonic Flight**—Supersonic speed in itself is not responsible for the conditions any more than is G-loading since the violence depends upon rotational speed, not forward speed.

As speed is increased there is a favorable reduction in the angle of attack. In addition, at high speed, pilots cannot employ the aircraft's roll controls as far.

The critical speed range is less than the maximum speed of the aircraft, and the condition can be encountered in subsonic flight.

Any effect of CG (center of gravity) location on this condition is minor. A shift in CG might affect when or how the condition appears but a change in CG within the normal limits of an aircraft is a secondary factor and would not solve the problem.

However, one of the changes on the F-100, the addition of 12-in. extensions to each wingtip, does give a more favorable CG.

▶ **No Trouble**—The erratic and dangerous condition, a horizontal spin, was made more mysterious by the fact that it was so rare. Apparently a violent unco-ordinated roll maneuver was necessary before the aircraft would enter its uncontrollable stage.

With the present fix, the pilots have done high rate rolls, completely uncoordinated, at all speed ranges within the F-100 capability without trouble.

New Missile Tags

USAF has adopted new nomenclature for guided missiles and new designations for missile organizations.

Examples of equipment designations:

- **Tactical Missile: TM-61 (Matador)**
- **Strategic Missile: SM-62 (Snark)**
- **Interceptor Missile: IM-99 (Bomarc)**
- **Guided Aircraft Rocket: GAR-98 (Falcon)**
- **Guided Aircraft Missile: GAM-63 (Rascal)**

Operating units will be known as tactical, strategic, or air defense missile squadrons or wings. The term "pilotless aircraft" has been dropped from USAF terminology.

Chief engineer Raymond Rice, in an article appearing in the current issue of the NAA magazine, Skyline, which described the investigation of one of the F-100 crashes, says Welch in his fatal dive "encountered some hitherto unsuspected mysteries of supersonic flight."

The Rice report of the investigation which followed that crash is a fascinating study of the infinite pains which were taken to round up every possible clue which might contribute to an explanation of the supersonic fighter's strange accident.

▶ **Rugged Test**—Welch's flight test card that day called for him to perform the most rugged structural test of the F-100 yet made. He was to make a supersonic dive with a symmetrical pull-up at medium altitude of 23,700 feet.

At 11 A. M., Welch reported by radio that he was directly over Mojave, ready to start the dive at his aiming point of Rosamond Dry Lake. That was his last radio report.

Two Air Force B-47 pilots enroute home to Castle Air Force Base, Merced, Calif., from a practice bombing mission over the Salton Sea gave an account of what happened.

They were flying at 25,000 ft. over Palmdale when they spotted the F-100 by its contrails at an estimated 45,000 ft. As they watched, Welch made a wingover to the right and began his dive some 3½ to 5 mi. ahead of and to the right of the B-47.

The Super Sabre passed their altitude in a 70 or 80-deg. dive, moving so fast they had to turn their heads quickly to follow it. As the F-100 continued steadily in its dive, it suddenly came apart in what appeared to the B-47 pilots as an explosion. They said that at no time did the Super Sabre give the impression of a violent maneuver, structural failure, or lack of control.

▶ **Ground Pattern**—North American design engineers flew to the scene to coordinate an investigation with USAF personnel from the Flight Safety Directorate at Norton AFB.

"The prime effort of the first phase was to determine the ground pattern of the wreckage, for much can often be learned from the pattern of pieces found on the ground in relation to the known direction of flight of the airplane at the time of disintegration," says Rice. "The intensive search made for every piece of the airplane paid off well, for virtually every portion of the ship was recovered."

Detailed maps were drawn to show the pattern of fall; parts were photographed where they lay and then trucked to NAA's Inglewood plant for study by the engineers.

"Piece by piece, scratch by unidentified scratch," says Rice, "they studied the effects of supersonic disintegration, trying to determine the order in which the pieces had come apart, to figure out which part had struck what section when, and ultimately to discover the biggest poser of all—why."

▶ **Film Recovered**—Typical of the painstaking methods used in reconstructing the accident was that which followed the discovery of exposed film from an electrically-operated camera mounted in the vertical stabilizer of Welch's heavily instrumented ship.

This camera had been trained on the left horizontal stabilizer to record its action during the dive. Although its electric power had been cut off when the aircraft disintegrated, the camera continued to grind from its own momentum for a few frames after the breakup. Searchers at the crash scene removed the film unharmed.

As empennage engineers viewed the developed film, they realized that an erratic shadow racing back and forth on the left horizontal stabilizer was being cast by the vertical stabilizer and rudder.

▶ **Shadow Duplicated**—They called Griffith Park Observatory for the known bearing and azimuth of the sun at the time and date of the accident. By using the light from a slide projector to serve as the sun in that position, and with a protractor to set the exact angle of heading and dive angle of Welch's aircraft, they duplicated the exact shadow on a scale model of the F-100. By making the shadow perform as it did in the film, they were able to recreate the exact gyrations the real tail section had performed 20,000 ft. in the air just before and during the breakup.

"But as reports from the various engineering groups began to take shape and specialists began to evolve a pattern from the separate studies," Rice continues, "there came a growing conjecture that 'something' other than a known structural failure or malfunction of a part had caused the accident."

Neither hydraulic nor electrical sys-

Navaid Decision: Get Tacan Ready

borne Instruments Laboratory, and

tems contributed in any way to the crash, studies indicated. There appeared to be no malfunction of the powerplant. The stabilizer was in the correct position and the landing gear was up and locked.

▶ **Important Clue**—Oscillograph records recovered at the scene, showing actual control forces and positions during the flight, gave what Rice calls the first and most reliable real clue as to the probable primary cause. The light-struck film was developed with the greatest of care.

"To insure getting the most out of the damaged portion of the film," Rice reports, "darkroom technicians cut the film into dozens of small sections and, starting from the inside where it was less fogged, began developing the film a section at a time. As they got to pieces that showed the effect of sunlight, they mixed increasingly stronger developers to correct for the defect, basing each new mixture on the results obtained in the previous section."

After copy and re-copying, legible prints were obtained.

▶ **Extreme Yaw**—"As a result," says NAA's chief engineer, "the records showed to aerodynamicists reading them that Welch had encountered an unexplainable phenomenon—a maneuver never before experienced under those conditions—which had probably caused the disintegration of the airplane."

This was an extreme, high, nose-right yaw. Exact degree is classified but Rice calls it "considerable." The formal report of the committee which studied the crash says: "The unprecedented high angle of yaw experienced during the test was in excess of the design limit of the airplane, thereby causing disintegration."

Study of Welch's accident and of the "new" design requirements which NAA engineers believe are necessary for supersonic aircraft is continuing. More than 3,000 man-hours went into the accident study alone. The computer REAC solved in three weeks design equations involving five degrees of freedom, computations that it would have taken one man more than 700 years to do. These were major contributions to solving the problems.

But no contribution exceeded that of George Welch. Rice's closing words are a fitting tribute to a fine and experienced test pilot:

"Our progress will be watched keenly by everyone connected with the science of aeronautics, for the simple fact is that we are now on the brink of being able to fly past the limits of our available research data.

"But because of Welch's priceless contributions we are now aware of some of the new problems—we have tangible things to determine answers. The future of all of aviation owes George Welch a debt of gratitude for leaving us this insight."

New Bell XV-3 Convertiplane Will Top 175 Mph.

Speed of more than 175 mph. is predicted for Bell Aircraft Corp.'s new XV-3 Army convertiplane when its three-bladed rotors are tilted forward 90 deg. to act as airplane propellers. Transition time from copter to airplane configuration is estimated at 10-15 sec., and stable flight will be possible with blades in any intermediate position. The four-place craft is powered by a Pratt & Whitney engine aft of cabin. Wingspan is 30 ft., length 30 ft. and height 13 ft. The company says the XV-3 is a medium-range aircraft. Rolled out Feb. 10 at Ft. Worth, Tex., the new XV-3 is scheduled for extensive tie-down tests prior to flight. Designed and built for U. S. Army under a joint USAF-Army development contract awarded in 1951, it originally was designated the XH-33.

Navaid Decision: Get Tacan Ready

But VOR/DME backers are not giving up; see opponents hitting snag in free channels for civil-military use.

Decision to complete the technical development of Tacan to clear the way for its adoption as the common system for short range navigation has been made by the Air Navigation Development Board.

The long-awaited decision (AVIATION WEEK Feb. 7, p. 12) may be only an interim solution to the problem. Backers of the civil VOR/DME system predict that eventual adoption may be snagged by an inability to provide sufficient interference-free channels required for joint civil-military use.

▶**Three Reasons**—The conclusion to proceed with Tacan came after these findings by ANDB's technical consultants:

- The Tacan system will provide direction accuracy within one degree while the comparable VOR accuracy is three degrees.
- VOR, for basic technical reasons, cannot provide satisfactory service when installed on Navy carriers.
- Civil VOR/DME system does not meet military needs for equipment which can be easily sited in military theaters of operation.

Col. Jack Taylor, executive director of ANDB says: "It is difficult to deny the military the system they request."

Taylor says that the evaluation program will take another six months. He expects that the Tacan system will be declassified in the near future and that manufacturing rights will be made available to all navigation equipment makers.

▶**Program Action**—Course of action outlined for the program includes:

- Finish development of Tacan to make it suitable for both civil and military users at the earliest possible date.
- Continue VOR as a common system navigation aid until 1965.
- Limit the use of civil DME facilities to experimental purposes, with the understanding that DME service is not guaranteed beyond June 30, 1955. This is to assure that DME frequencies would not stand in the way of Tacan if it later is standardized.
- Permit military services to install Tacan facilities to meet their minimum interim requirements, for the present, on a basis that will be non-interfering with channels assigned to civil DME.

▶**Back-Up Plan**—ANDB plans to develop a CW (continuous wave) omnirange facility in a higher frequency band as a back-up plan if Tacan proves unacceptable or inadequate. The present civil DME would provide distance in the back-up system, and the present DME ground equipment will be held in readiness.

Robert B. Murray, Jr., former Undersecretary of Commerce and now a special consultant to the Secretary of Commerce, said in a letter to ANDB chairman Donald A. Quarles: ". . . Because of the over-riding priority the Air Force and Navy have assigned to Tacan, and because we must have a single civil-military system capable of immediate integration with air defense system of the United States, I find I have no alternative but to reluctantly concur with the course of action adopted."

Civil Aeronautics Administration had spent in the neighborhood of $20 million for the installation of DME units with 215 commissioned on Jan. 1. Total program was 432 DME's.

CAA probably will withdraw its request for additional DME funds before congressional hearings open.

"It was a good idea to clear the air on this situation," said one top official. "Certainly the government wasn't acting in good faith with airways users to permit any situation that would encourage people to buy DME sets."

▶**History of Systems**—Murray outlined the background of the civil DME-military Tacan controversy in his letter to Dr. Quarles, who is also Assistant Secretary of Defense for Research and Development.

He said one of the casualties of the military buildup resulting from Korean hostilities was the VOR/DME as a common civil-military system.

"Military necessity rushed the development of a tactical navigational system required for national defense and mobilization. . . By 1952 it was generally acknowledged that a military short range system called Tacan existed. Tacan and VOR/DME for technical reasons are not compatible. By 1952, commerce and defense were heavily committed on their respective systems," Murray stated.

▶**Facing Facts**—"Every month's delay in resolving this conflict of systems was extremely expensive in dollars, time, national defense and the eventual resolution of the truly common system. Any further delay now in facing up to the facts would just result in still more damage," he said.

Defense and commerce, through ANDB, formed a Vortac committee to assemble and analyze information on the two systems. The committee was aided by R. C. Newhouse, Bell Laboratories; H. R. Skifter, president, Airborne Instruments Laboratory, and J. B. Wiesner, director, Research Laboratory of Electronics, Massachusetts Institute of Technology.

The committee was unable to reach a unanimous decision. The majority supported the Tacan plan.

▶**Military Position**—"The military," Murray said, "which supports the majority position has firmly stated they need navigation equipment with a very high degree of accuracy which can be mounted aboard ship and which is also capable of rapid and simple ground installation. The expert consultants state that VOR does not meet these requirements as well as Tacan.

"The military also expressed the immediate urgency of their needs for Tacan for tactical and national defense purposes. The military departments are presently committed to the world-wide implementation of the Tacan system and are forced to proceed immediately through United States and NATO channels with its implementation," Murray said.

Unofficial estimates of the programmed cost of Tacan is $325 million.

Only users of airborne DME equipment at the present time are a limited number of business aircraft.

Col. Taylor says that no difficulty is anticipated in putting the Tacan "black boxes" in aircraft space planned for DME.

EAL-Colonial Merger Taking Shape Again

After several years of hearings, rehearings, White House reviews and stock control disputes, Eastern Air Lines-Colonial Airlines merger finally appears to be taking shape.

Colonial management announced last week it has accepted Eastern's offer for CAI to merge with EAL on the basis of a stock issue of one share of Eastern for every two shares of Colonial. The move still is subject to approval by Colonial's stockholders, Civil Aeronautics Board and, since international routes are involved, the President.

In a brief submitted to CAB examiner Edward Stodola last week Eastern emphasized that it does not now exercise any control over Colonial, declaring that every factor on which the examiner's previous finding as to Eastern's control has been completely eliminated.

The company said all of the 110,500 shares of stock claimed to have been within Eastern's "orbit" have moved into hands unknown, have been neutralized by voting trust, or are in hands never identified with EAL. Only exception to this are 800 shares of Colonial's total 515,600 shares.

Talkeetna, USAF and Army Engineers crably less without aerial refueling. This 1955, the two services obligated a total

Alaska Airstrips

- **Compacted snow runway widens USAF mobility.**
- **Goal is to keep aircraft operating if Reds attack.**

By Claude Witze

Elmendorf AFB, Alaska—Exercise Snowbird, joint Army-Air Force maneuver completed near here last week, proved the snow compacted runway is capable of handling any type of equipment USAF wants to put on it.

As far as Snowbird is concerned, this meant a C-47 transport.

The emphasis in this type of foot soldier operation was placed on the fact that troops in these frozen wilds must have air service if they are to live and fight.

▶ **Alaska Strategy**—But the utility of the compacted runway for bomber and fighter operations in an age of nuclear warfare was not overlooked.

After nearly 3,000 paratroopers had been landed to clear the cold Talkeetna area of "enemy" forces, Lt. Gen. J. H. Atkinson, commander-in-chief of Alaska, said he does not anticipate any big land campaigns ever will be fought in Alaska.

What we have to defend in the territory is America's retaliatory capacity by air. An enemy attack on Alaska from across the Bering Strait or any other direction will be from the air. Its object will be to keep USAF grounded, not to kill soldiers in the U. S. Army.

It is for this reason that both Gen. Atkinson and Maj. Gen. George R. Acheson, head of the Alaskan Air Command, say the defense effort in this part of the world now must concentrate on three things:

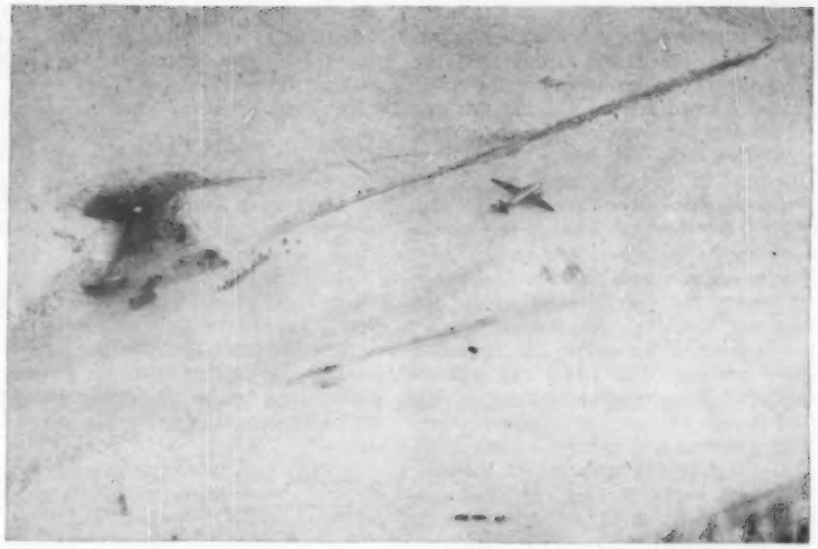
- Improved early warning radar network.
- Improved anti-aircraft defense, including installation of Nike missile stations.
- More outlying airstrips for use by fighter planes.

It is not their intention to provide a potential enemy with any more major targets in Alaska. But it is their goal to keep USAF operating despite enemy attack and the cold weather. This goes for transports, fighters and the bombers flown by Strategic Air Command.

▶ **'Eight Men, Five Days'**—To help in this job, USAF has an Alaskan sourdough of 22 years' experience on its payroll. His name is Fritz Awe, and he says: "Give me eight men and five days and we'll build a snowstrip any place in Alaska."

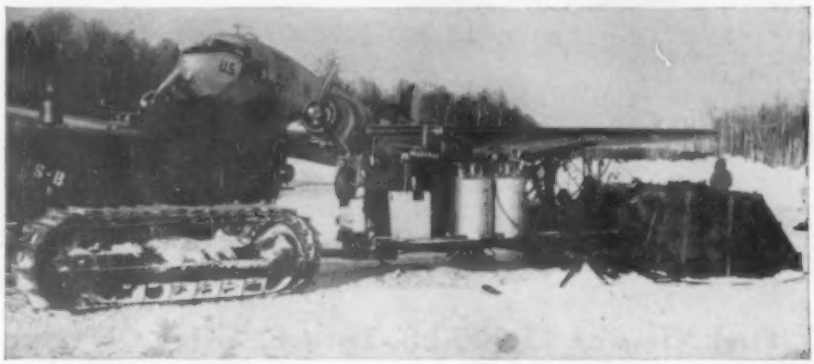
He could add that compacted runways can be built anywhere where nature provides enough snow and subfreezing temperatures, even on the other side of the Bering Strait where Russian planes today can be tracked when they fall within range of U. S. radar outposts.

Building the runway is simple. Working in less than four feet of snow at



COMPACTED SNOW RUNWAY receives USAF Douglas C-47. Orange-dye centerline guides pilot. Army Engineers built the strip at Talkeetna, 66 mi. north of Anchorage.

DENT MADE BY IMPACT of C-47 landing on snow runway is measured by U. S. Army Engineers. Behind them are the plow and logs used to prepare strip for pulvi-mix operation.



PULVI-MIX EQUIPMENT comprises tractor, compressor with fuel, tilling device and heater. Heater melts the snow sufficiently to make the crystals pack firmly together for hard surface.

Talkeetna, USAF and Army Engineers pushed aside a top layer of loose crystals, then rolled and compressed the remainder. To finish the job, the Army has developed a Rube Goldbergish machine that harrows the surface, mixing into the snow any brush or soil that happens to be in the way.

▶ **Speed, Mobility**—Called the "Pulvi-Mix," the machine finishes the job by searing the surface with a jet blast that melts surface snow crystals. As soon as it passes, the water freezes, giving the runway a strong, solid surface.

In Exercise Snowbird, this operation was realistic. The troop carrier force dumped its own specialist who marked off the drop zone. Army Airborne Engineers cleared and rolled the snow. Aviation Engineers from the 813th Engineer Aviation Battalion took over final construction, widening and lengthening of the runway.

USAF spokesmen said the snow runway may be essential to fighter operations in arctic areas. There is great emphasis today on speed and mobility, but both can be useless unless the land can provide suitable landing and launching platforms.

▶ **Bomber Staging**—To the jet pilot in combat, an airstrip can be more than an emergency landing field. It can help him concentrate firepower despite range limitations, crowding the enemy from advanced and camouflaged bases.

In the open, there has been no discussion of how the compacted runway can be used by the Strategic Air Command. SAC had observers at Exercise Snowbird, but none of its planes was evident.

USAF has flown the C-124 in and out of compacted runways. Its gross weight is about the same as that of the B-47 jet bomber. B-47 range is considerably less without aerial refueling. This indicates the snow runway would be a practical forward staging for longrange strategic bombers.

▶ **Ice Fog Problems**—Another factor, strange to new arrivals at cold weather USAF bases, is the phenomenon of ice fog. Landings can be made hazardous by the sudden and artificial introduction of moisture into a mass of cold air.

This happens over a landing strip while the surrounding atmosphere is clear. Takeoff of two planes from a runway can upset the moisture balance, producing a fog that closes the strip immediately. Opening of hangar or heating plant doors can bring the same result.

At a critical moment, an emergency snowstrip close to the main base, might save lives and equipment.

Air Force Obligations Reach Two-Year Peak

Air Force in December reached its highest peak in obligating funds for aircraft and related procurement in two years, with obligations for the month totaling more than $1.6 billion. This exceeded USAF's obligations of $1.2 billion for the previous five months of fiscal 1955.

Order cancelations in December exceeded Navy's obligations for aircraft and related procurement by $24 million.

This was the status of funds for the overall category of "aircraft and related procurement"—which includes funds for guided missiles, industrial mobilization, plus salaries and other expenses connected with procurement—as of Jan. 1:

- During the first six months of fiscal 1955, the two services obligated a total $3.6 billion (USAF, $2.8 billion; Navy, $735 million).
- Unobligated funds totaling $8.9 billion were on hand Jan. 1 (USAF $6.6 billion; Navy, $2.3 billion).
- The two services expended $4.2 billion during the first six months of fiscal 1955 (USAF, $3.2 billion; Navy, $948 million).
- Unexpended funds on Jan. 1 totaled $22.8 billion (USAF, $15.3 billion; Navy, $7.3 billion).

AF Sets Up 3-Airline Cargo Lift to Formosa

Seaboard & Western Airlines, Flying Tiger Line and Transocean Air Lines have received Air Force contracts to operate an undisclosed number of military flights between the U. S. and Formosa.

With tension in the Formosa area mounting, USAF is trying to get as much available airlift as possible. The three airlines are scheduled for cargo shipment to the Nationalist China island, with the majority of return flights slated for passengers.

For Seaboard, this will mark the first time its Super Constellation freighters have been used in trans-Pacific service. S&W currently operates the transports only on its trans-Atlantic cargo service flights.

Air Force is believed to be particularly interested in using the Super Connies for the Formosa airlift because of its easy convertibility from cargo to passenger configuration.

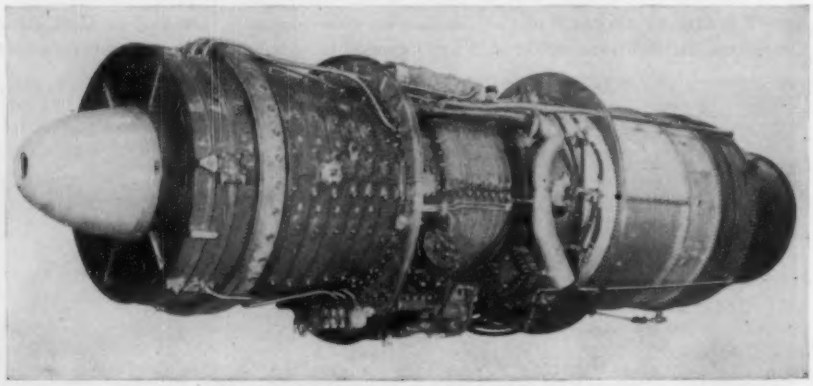
Twining Says Russian Air Quality Improved

Russia's air force has not grown noticeably larger in the past year, but the quality of its equipment has improved significantly, according to Gen. Nathan F. Twining, USAF Chief of Staff.

Gen. Twining told the National Council of the Reserve Officers Assn. that the recent Soviet announcement of a sizable increase in the military budget and continued emphasis on heavy industry are important factors in America's defense planning.

He said, "There are indications they are converting their air defense forces to more modern jets," while adding jets to the Russian bomber force. This improved airpower combines with Soviet progress on nuclear weapons to form the main military threat to the United States.

Twining emphasized that USAF, already outnumbered in total of aircraft, must bridge the gap with better planes and equipment.



First View of 11,000-Lb.-Thrust Bristol Olympus

Closeup three-quarter front view shows external details of new Bristol Olympus 101 twin-spool turbojet that has been type-tested at 11,000-lb.-thrust takeoff (Aviation Week Feb. 7, p. 18). British also claim a continuous cruise power of 9,600 lb. thrust for the 101. Military designation is BOL 1/2C. The 150-hr. type-test program included 5 hr. running at takeoff power, 87.25 hr. at cruise conditions, 10 hr. alternating between ground idling and takeoff and a short overspeed run. After successful trials, Ministry of Supply has approved the 101 at 11,000 lb. thrust without afterburning.

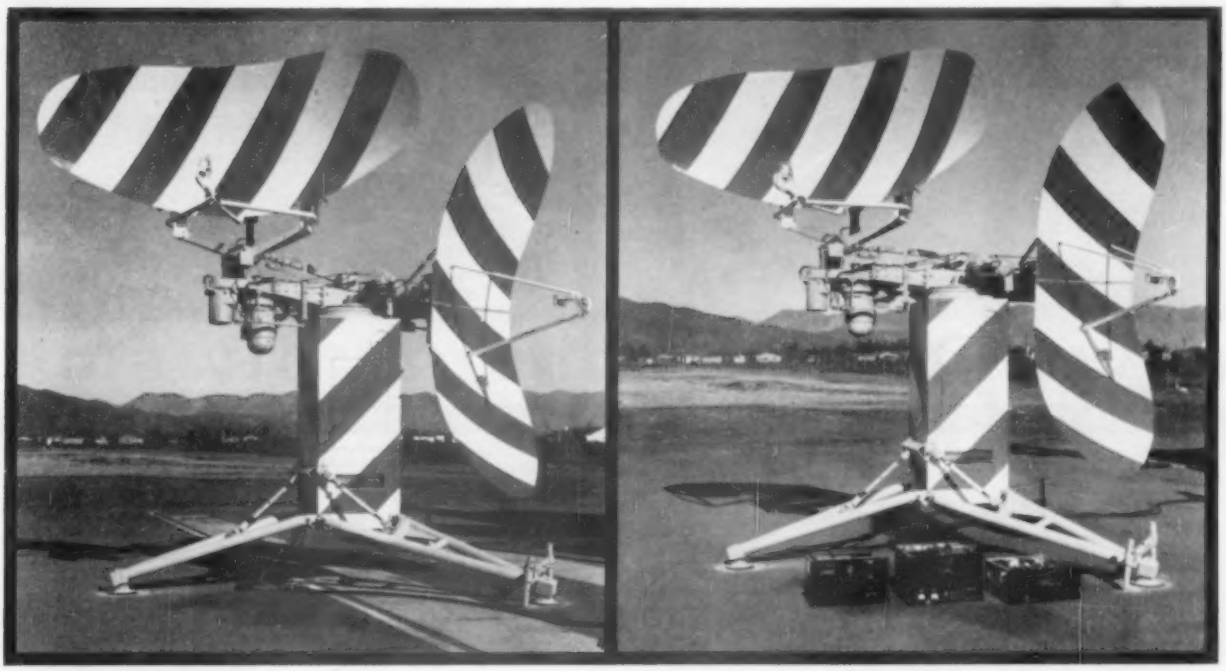
New higher power GCA **QUADRADAR** unveiled by Gilfillan

Two Models Now Meet Complete Range of Air Traffic Problems

Over two hundred international aviation visitors to the successful demonstrations of the 50 kw. GCA Quadradar during November and December 1954 in Los Angeles were also shown a completely new higher power 200 kw. Quadradar.

The 50 kw. Quadradar in field demonstrations and during the U. S. Air Force and U. S. Army operational evaluation tests now under completion exceeded both military and civil airport requirements. Now the 200 kw. Quadradar provides even greater performance capabilities with 40% increased range and altitude coverage over the 50 kw. equipment.

Both the 50 kw. and the 200 kw. Quadradar have complete remoting controls and instant multiple runway coverage.



50 kw. Quadradar operated perfectly during several recent California rainstorms. Successfully tracked F-86 jet fighters beyond 30 miles and above 20,000 ft. Both 50 kw. and 200 kw. models (at right) include proven circular polarization to eliminate rain and snow clutter.

GCA RADAR AND ELECTRONICS
Gilfillan
LOS ANGELES
GCA
AROUND THE WORLD

200 kw. Quadradar provides 40% additional coverage in range and altitude. Both models are identical except for three small components — transmitter, receiver and high voltage power supply — as shown. These 3 components quickly plug in to replace the 50 kw. components.

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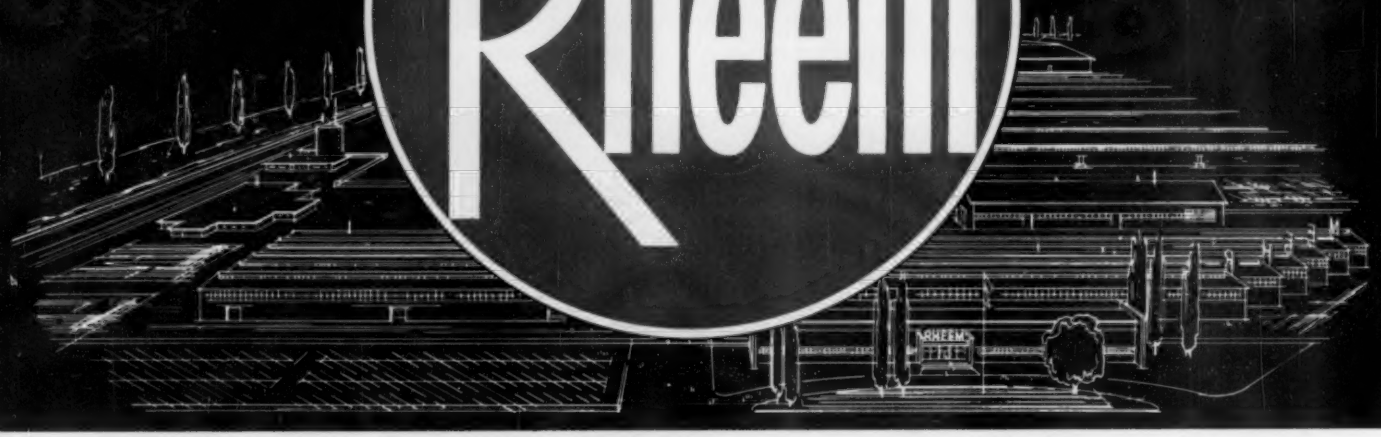

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Operation Pacemaker

	Fiscal 1954		Fiscal 1953 (in millions)		Fiscal 1952	
Total awards on procurement of items in small business potential	$365.1	100%	$479	100%	$639.7	100%
Awards to small business	291.8	80%	335.8	70%	383.7	60%
Reasons for awards to other than small business:						
No bids received from small business	$ 3.9	1.0%	$ 9.9	2.0%	$ 20.0	3.1%
Price out of line	31.9	8.73%	59.9	13.0%	67.1	10.5%
Unqualified technically	2.5	.7%	10.2	2.0%	4.9	.8%
Unqualified physical facilities	None		3.8	.8%	6.8	1.1%
Unable to meet delivery schedules	None		9.9	2.0%	70.1	11.0%
Emergency procurement	.06	.02%	4.1	.9%	2.9	.5%
Bids not according to specifications	1.05	.3%	1.06	.2%	7.9	1.1%
Broadening and maintaining the base	31.1	8.52%	39.1	8.0%	None	

Why Small Firms Lose AF Orders

The need for broadening and maintaining America's mobilization base is a growing factor in the struggle of small companies to get a larger share of Air Force business.

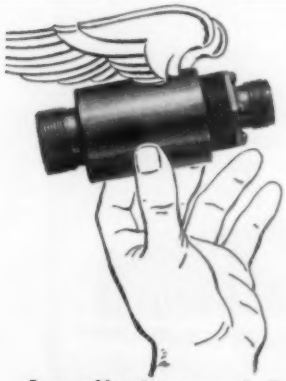
Brig. Gen. Thomas P. Gerrity, USAF director of procurement and production engineering, has released studies showing that when small business can do a job but fails to win the contract the blame usually can be traced to one of two reasons:

- **Small business** prices are out of line.
- **Big business** was given the order to keep an essential plant facility in operation and protect it as a source in case of national mobilization.

Gerrity's figures were assembled through Operation Pacemaker, USAF's special project aimed at increasing small business participation in the procurement program (AVIATION WEEK Sept. 27, 1954, p. 19). They involved only unclassified contracts of $10,000 or more in value.

▶ **Price Factor**—Pacemaker's study reveals that the need to broaden and maintain the mobilization base was a factor of no importance in 1952—but took 8.5% of the small business potential away from these firms in fiscal 1954. This business was worth more than $31 million.

Prices were equally important, responsible in fiscal 1954 for a loss of 8.73% of the small business potential. However, there has been a big improvement in this situation. In fiscal 1953, the figure was 13%; and in fiscal 1952 it was 10.5%, indicating that small fighters and trainers, plus a 50% increase in overhauling planes leased to reversal of the sharp downward trend in



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Neptune rules the seas from the skies!

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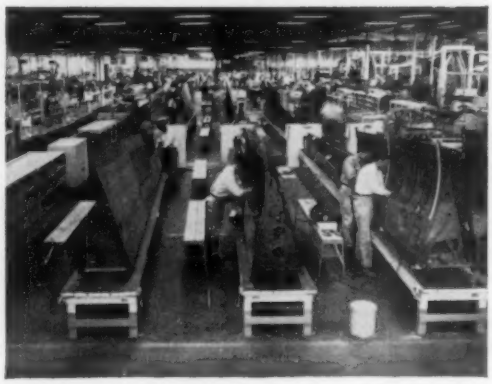
Lockheed's Navy patrol bomber, the *Neptune*, is aptly named, for it is capable of firmly ruling the sub-surface deep that was once the private domain of the submarine. No longer is it necessary to *sight* subs, the *Neptune* can *sense* them hundreds of feet below the surface. Its amazing electronic search-gear coupled with record setting range and endurance make it a most formidable weapon.

Typical of the efficient cooperation that answers defense demands in this competitive, free-enterprising industry, Lockheed awarded TEMCO a sub-contract for the manufacture of complete outer wing assemblies for the *Neptune* in late 1950. TEMCO has supplied these components to Lockheed ever since — a quality product, delivered on schedule, at the lowest possible cost.



Neptune P2V wing panels taking shape on the assembly line at TEMCO's Dallas plant. One of many major components manufactured by TEMCO for other outstanding aircraft companies.

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AVIATION CALENDAR

the figure was 13%; and in fiscal 1952 it was 10.5%, indicating that small business prices have become more competitive with those of big business.

In fiscal 1954, small business did not lose any of its potential because of inability to meet delivery schedules. This is an improvement over fiscal 1952, when 11% of the potential, or more than $70 million in sales, was lost for this reason.

USAF spokesmen say action was taken as soon as the trouble was spotted more than two years ago, and adjustments were made to lower this hurdle to small business wherever possible.

▶**Loss by Forfeit**—Another result of Pacemaker's effort is a steady decline in the amount of small business forfeited by failure of firms in this classification to make a bid.

In 1952, $20 million dollars in goods that could have been made by small business went to large firms by simple default. This was more than 3% of the small business potential. In fiscal 1954, this figure was cut to 1%, worth less than $4 million.

USAF's overall small business program, Gerrity's office reports, resulted during 1954 in award of $556 million of contracts to these firms out of a potential of $773 million, or 76%.

Of 5,600 contracts worth more than $10,000 each, the average given to small business in the last fiscal year came to $76,000.

The report also shows there is no appreciable difference between negotiation and formally advertised procurements as a source of business for small firms. Of contracts worth more than $10,000, small business firms won 83% of the 2,028 formally advertised as suitable to their type of operation. They also won 82% of the 2,114 contracts in the same class awarded by negotiation.

Dollar value of the negotiated group was more than $350 million, in contrast to about $75 million for the business won as a result of advertising.

Japan Expects Boost In U.S. Air Business

(McGraw-Hill World News)

Tokyo—Japanese defense industry officials expect the U.S. to step up its aircraft repair and purchase orders in Japan this year as a result of President Eisenhower's budget plea for increased fund disbursements for air defense.

USAF procurements in Japan during the last four years accounted for only $33 million, or 18% of the total purchases by air and naval units in the Far East.

Expansion in orders is expected to include production and repair of jet fighters and trainers, plus a 50% increase in overhauling planes leased to Japan's defensive air force.

Three Air Agencies To Increase Staffs

Substantial increases in the personnel of Civil Aeronautics Administration, Civil Aeronautics Board and National Advisory Committee for Aeronautics are programmed for fiscal 1956 under the President's budget.

These increases are planned:

• **CAA**, 765, from a total of 15,519 in fiscal 1955 to 16,284. This marks a reversal of the sharp downward trend in CAA employment since the Eisenhower Administration came into power. Permanent positions, which totaled 16,041 in fiscal 1954, dropped by 522 in 1955.

• **CAB**, 69, from 555 in fiscal 1955 to 624 in fiscal 1956. Board personnel declined slightly this year, from 558 in fiscal 1954.

• **NACA**, 860, from 7,719 in fiscal 1955 to 8,579. The total was 7,157 in fiscal 1954, 562 below the 1955 level.

The major part of CAA's increase would be in the administrative category of "operation and regulation," which would mount by 614 to a total of 15,338 in fiscal 1956.

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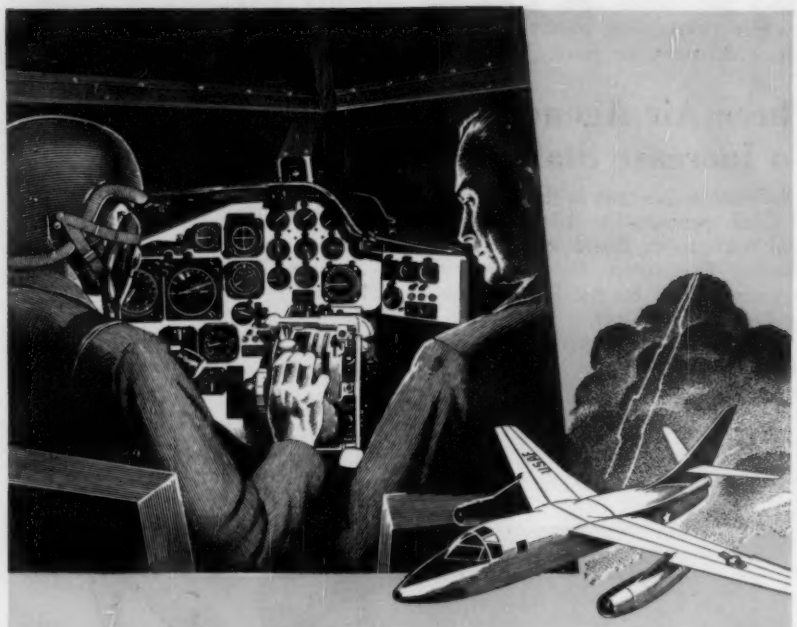

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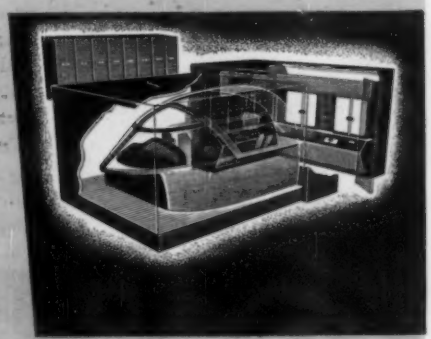

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Feb. 20-22—Fourth annual Texas Agricultural Aviation Conference, A&M College of Texas, College Station, Tex.

Feb. 20-22—Institute of Surplus Dealers, trade show and convention, 212th AA Armory, New York.

Feb. 21-22—National Model Plane Show, Higbee Co. auditorium, Cleveland.

Feb. 22-25—International Air Transport Assn., four-day conference of airline public relations directors, Kurhaus Hotel, The Hague.

Feb. 23-25—Fourth annual Ohio-Indiana Agricultural Aviation Conference, Purdue University, Lafayette, Ind.

Feb. 26-27—Associated Glider Clubs of Southern California, ninth annual Pacific Coast Mid-Winter Soaring Championships, Torrey Pines Glider Port, San Diego.

Mar. 11—Institute of the Aeronautical Sciences, National Flight Propulsion Meeting (restricted), Hotel Carter, Cleveland.

Mar. 14-16—Society of Automotive Engineers, production meeting and forum Netherland Plaza, Cincinnati.

Mar. 14-18—American Society of Tool Engineers, first Western Industrial Exposition, Shrine Auditorium and Convention Hall, Los Angeles.

Mar. 20-23—Aero Medical Assn., 26th annual meeting, Hotel Statler, Washington, D. C.

Mar. 21-24—Institute of Radio Engineers, national conference, Waldorf-Astoria Hotel, Kingsbridge Armory, New York.

Mar. 28-Apr. 1—American Society for Metals, ninth Western Metal Exposition and Congress, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles.

Mar. 31-Apr. 1—Symposium on Boundary Layer effects in Aerodynamics, Britain's National Physical Laboratory, Teddington, England.

Apr. 5-7—Radio Technical Commission for Aeronautics, spring assembly and joint meeting with the Institute of Radio Engineers, Los Angeles.

Apr. 6-10—World Plastics Fair & Trade Exposition, National Guard Armory, Los Angeles.

Apr. 14-15—American Ordnance Assn., symposium of Proving Ground Instrumentation Committee, Patrick AFB, Fla.

Apr. 16-20—American Association of Airport Executives, 1955 annual convention and business meeting, El Conquistador Hotel, Tucson, Ariz.

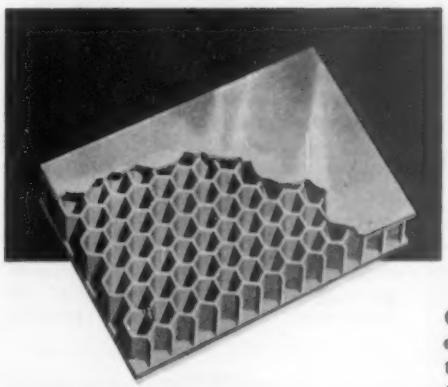
Apr. 18-21—Society of Automotive Engineers, Golden Anniversary Aeronautic Meeting, Aeronautic Production Forum and Aircraft Engineering Display, Hotel Statler and McAlpin Hotel, New York.

Apr. 18-21—American Society of Mechanical Engineers, Diamond Jubilee spring meeting, including four aviation sessions, Lord Baltimore Hotel, Baltimore.

Apr. 20-22—American Rocket Society, spring meeting, Baltimore.

Apr. 27-29—Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Los Angeles.

Apr. 28-30—American Helicopter Society, 11th annual forum, Hotel Mayflower, Washington, D. C.



HOW BONDOLITE EXTENDS THE REACH OF THE TIGER'S CLAWS!

GRUMMAN'S sharpshooting F9F-9, new supersonic Navy jet fighter, is a leading example of the utilization of a versatile engineering material to save weight and thereby extend the fuel capacity and range of today's aircraft.

Designers at Grumman called for liberal use of Bondolite, the lightweight structural sandwich fabricated by Goodyear Aircraft Corporation, in the flooring and fuel- and cockpit-compartments of the F9F-9 "Tiger"—and other progressive designers throughout the industry are making similar call-outs.

WHY this confident engineering acceptance of Bondolite for structural applications involving both shear and compression loads? It is the result of the techniques, facilities and exacting controls developed by Goodyear during its unparalleled *25-year experience* in fabricating structural sandwiches for aeronautics.

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How the Comet Mystery Was Solved—Part II

Giant 'Jigsaw Puzzle' Gives Final Clue

By David A. Anderton

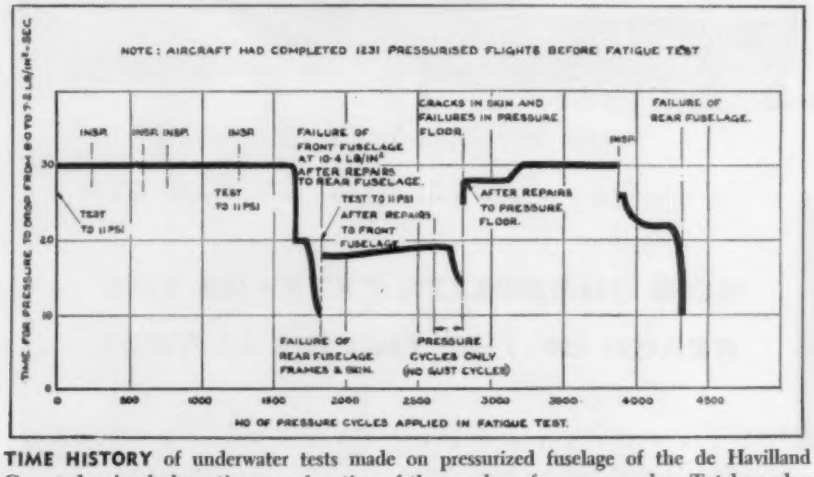
An errant piece of structure was the final clue to the destruction of the de Havilland Comet G-ALYP near Elba last January.

Blasted out of the port side of the pressurized cabin by the explosive failure of the fuselage, the torn structure skittered along the port wing to the aileron, leaving scratches and abrasions as it passed.

It was one of the last pieces of wreckage to be found. When it was matched to the abraded streaks in the wing, the scientists under Sir Arnold Hall at the Royal Aircraft Establishment, Farnborough, felt the goal was in sight.

Three days later the first fatigue failure occurred in the submerged test Comet, and the investigation was definitely on the final approach.

▶ **Reckoning**—The RAE engineers worked tirelessly through the English springtime, testing, destroying, building pieces of the proud Comet. The heaps of evidence still lacked direction. Somewhere there was one missing piece, one test unperformed that would solve the riddle.


NOTE: AIRCRAFT HAD COMPLETED 1231 PRESSURISED FLIGHTS BEFORE FATIGUE TEST
TIME FOR PRESSURE TO DROP FROM 8.0 TO 7.2 LB/IN²-SEC
INSP.
INSP. INSP.
INSP.
FAILURE OF FRONT FUSELAGE AT 10·4 LB/IN² AFTER REPAIRS TO REAR FUSELAGE.
CRACKS IN SKIN AND FAILURES IN PRESSURE FLOOR.
FAILURE OF REAR FUSELAGE.
INSP.
TEST TO 11 PSI
TEST TO 11 PSI
TEST TO 11 PSI AFTER REPAIRS TO FRONT FUSELAGE
AFTER REPAIRS TO PRESSURE FLOOR.
FAILURE OF REAR FUSELAGE FRAMES & SKIN.
NO. OF PRESSURE CYCLES ONLY (NO GUST CYCLES)
0
800
1600
2400
3200
4000
4800
NO OF PRESSURE CYCLES APPLIED IN FATIGUE TEST.

TIME HISTORY of underwater tests made on pressurized fuselage of the de Havilland Comet showing leakage time as a function of the number of pressure cycles. Total number of cycles is abscissa value plus 1,231, the number of logged flights before the test.

It was found on the first day of summer, when Sir Arnold and Ripley were looking at the wreckage. The fuselage stood stark on raw wooden bones and nearby, the burned and torn wings formed a giant's jigsaw puzzle on the concrete floor. Hall and Ripley looked, perhaps for the thousandth time, at the pieces, and then both had the same idea.

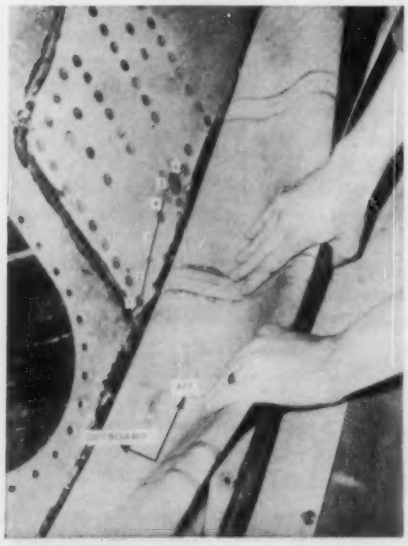
There were lateral scratches and marks on the port wing. Either a piece had blown out of the fuselage or the airplane had been in an extreme yawed condition when a detached piece hit the wing. Those were the only possible ways to explain the scratches.

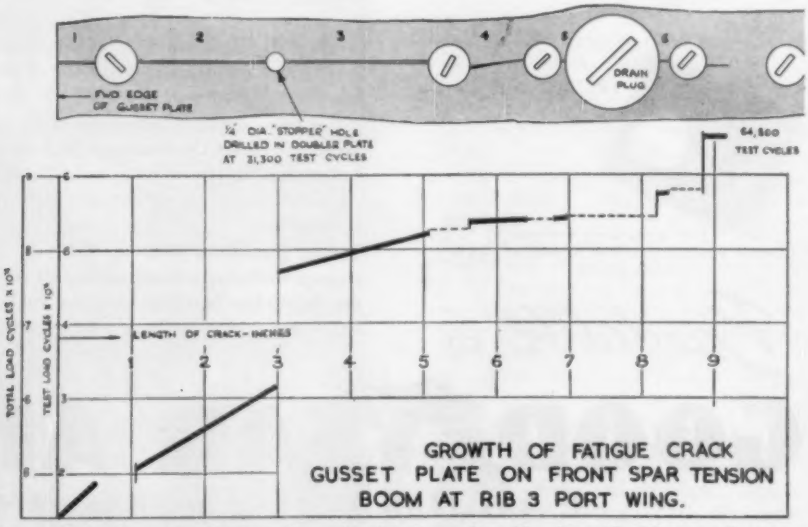
To Farnborough the same day, along with other pieces dredged from the bottom of the Mediterranean, came the missing cabin structure—a piece blown out of the side of the fuselage like a cork of a bottle. It was marked with the gold-edged, blue "B" of BOAC's standard marking for the Comet fleet.

▶ **Sherlocks With Paint**—Within a few days, Hall's men knew that it was this plug that had blown across the wing at high speed, blasted out violently enough to pass almost the entire semi-span before being whisked aft by the slipstream.

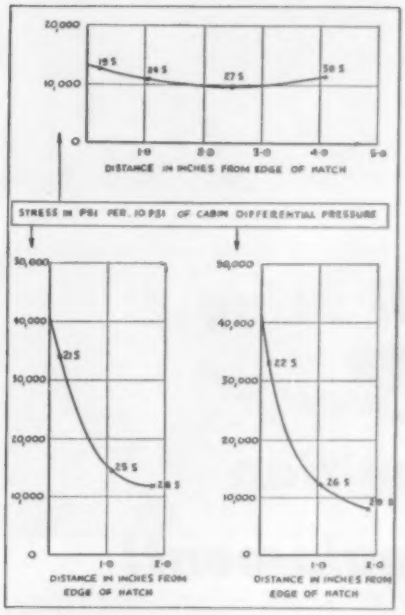
They knew, because the paint gave the answer.

Inboard on the wing, there were tiny flecks of gold and blue paint imbedded in the scratches. Outboard, the scratches were smaller and lighter; no paint marks were visible. But chemical




1
2
3
4
5
6
DRAIN PLUG
FWD EDGE OF GUSSET PLATE
¼" DIA. "STOPPER" HOLE DRILLED IN DOUBLER PLATE AT 21,300 TEST CYCLES
64,800 TEST CYCLES
TOTAL LOAD CYCLES x 10⁴
TEST LOAD CYCLES x 10⁴
LENGTH OF CRACK-INCHES
GROWTH OF FATIGUE CRACK GUSSET PLATE ON FRONT SPAR TENSION BOOM AT RIB 3 PORT WING.

CRACK GROWTH on tension side of Comet front spar is shown in photo and graph of test results. Numbers identify growth stages.



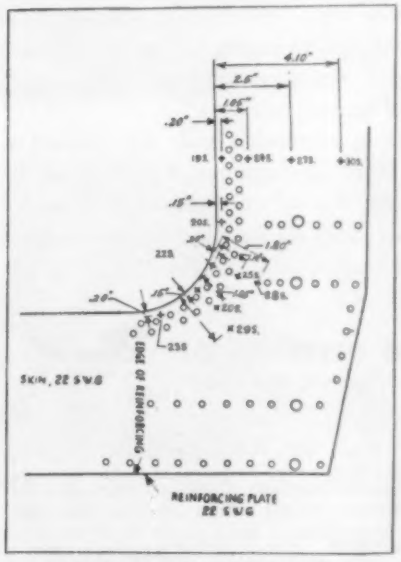
STRAIN GAGE readings around corner of forward ADF window show variation in stress with distance from edge, point up concentration around holes in stressed skin.

tests found traces of the special paint used on the Comet fuselage markings.

At about the same time, the fuselage of the submerged test Comet—G-ALYU—blasted open, starting from a fatigue crack at a rivet hole near a corner of an escape hatch.

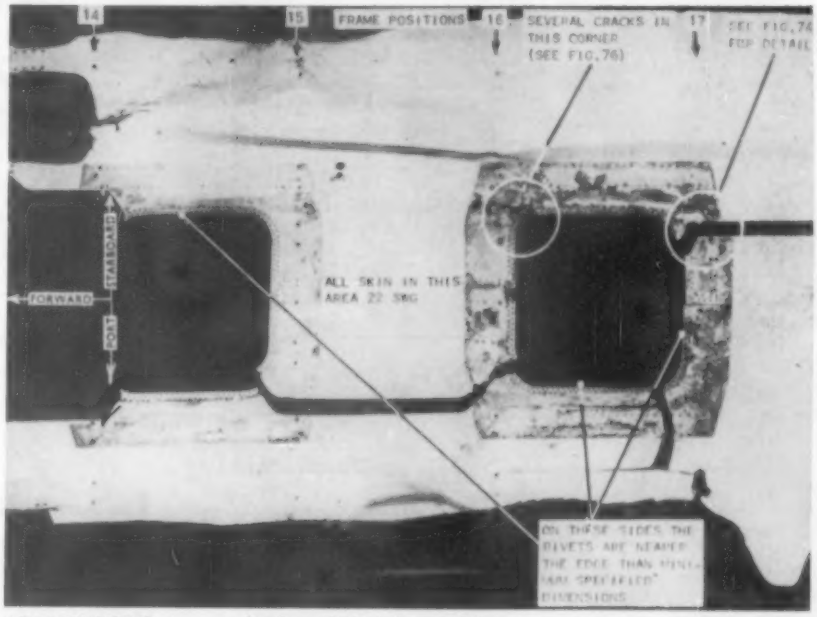
These two events had the closest relation of any of the tests or examinations so far, and Hall felt the first warmth, as he said, of the entire investigation.

▶ **Failure Sequence**—There was enough of the wreckage assembled to establish that the Elba Comet had broken up

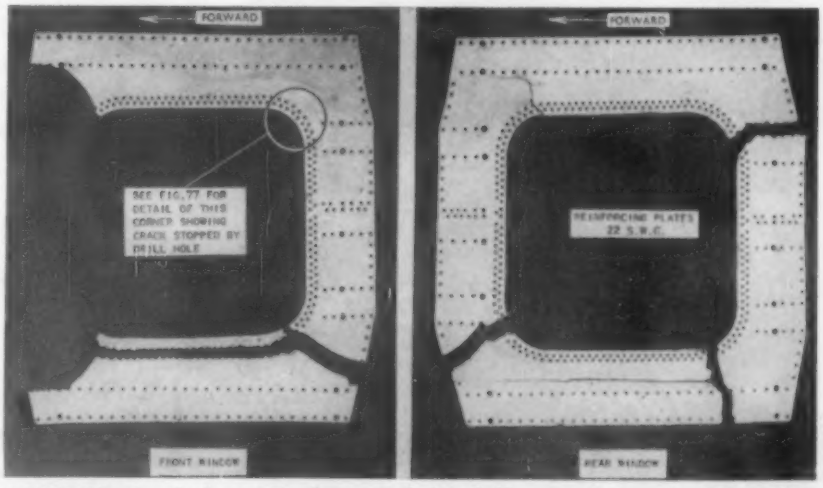


STRAIN GAGE LOCATIONS

DOTTED LINES show Comet cabin failure areas. Forward section blew out first at . . .

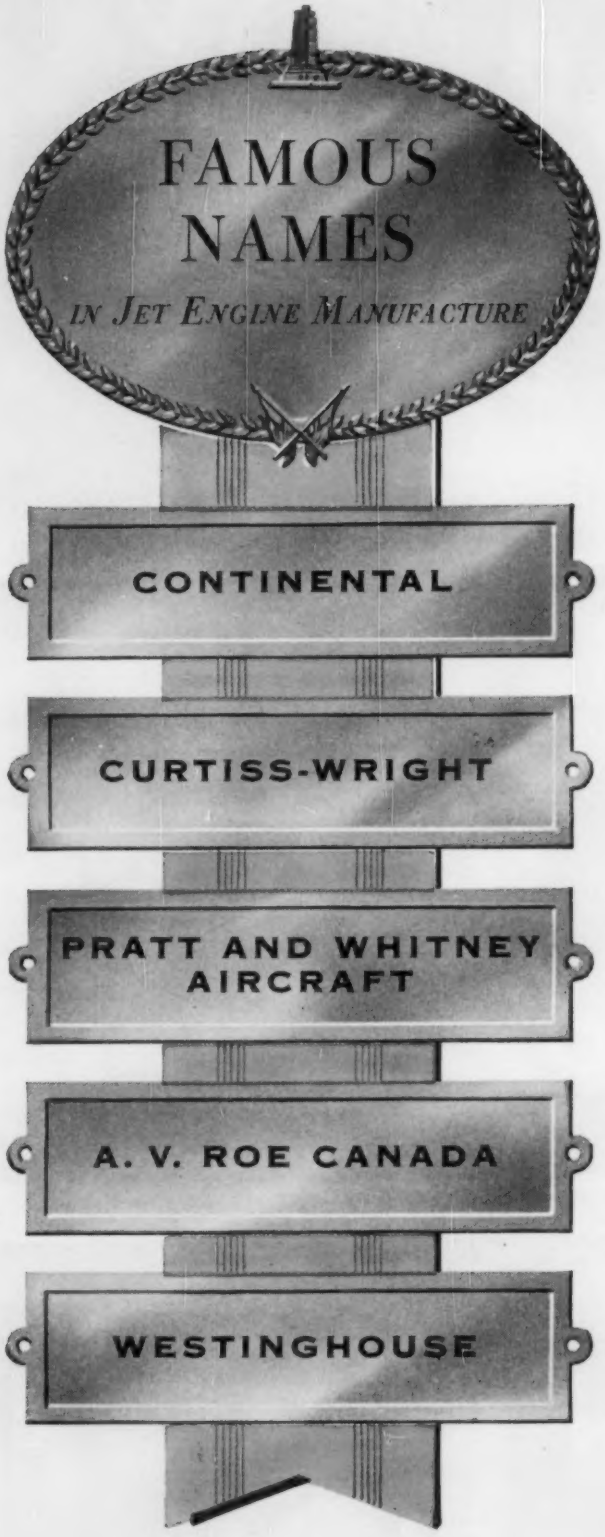


ADF WINDOWS on upper fuselage. Initial fatigue failure at corner tore stressed skin and . . .

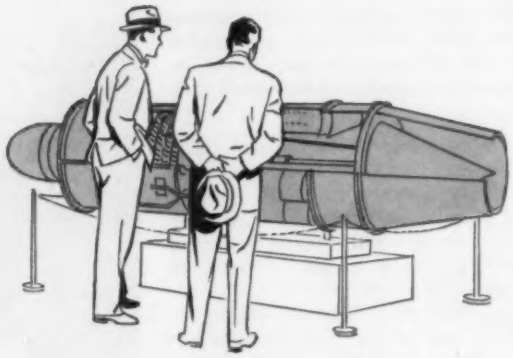


DOUBLERS, ripped along main frames and forced blowout of forward cabin section.

into six major units: fuselage nose, fuse-



.....all using Bendix ignition equipment!



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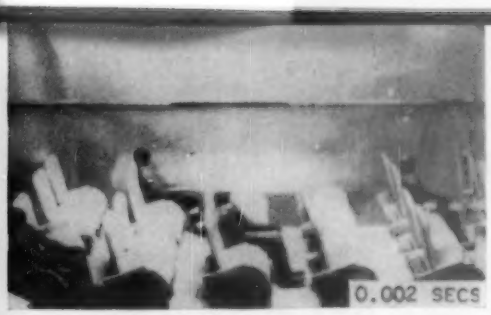
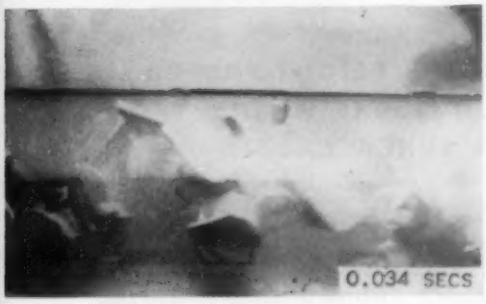
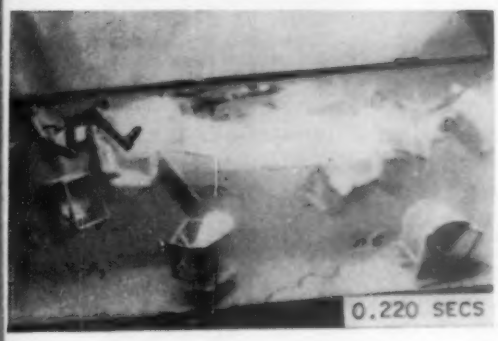






PLASTIC CABIN models under pressure were burst to determine consequences. Times are model times, must be multiplied by 3.18 for full-scale results. Seat backs start forward motion in second picture.

into six major units: fuselage nose, fuselage tail, center section with powerplants, port outer wing portion, starboard outer wing portion and the top center of the fuselage.

RAE had also established some sequence: the tail had fallen before the nose section, for example. They further knew that the failures had been in a downward direction (referred to the airplane as flying straight and level, because it may have been in any attitude at the time of breakup). Now they could find the fuselage failed first.

Here again paint marks furnished the evidence. Obviously the wing had been intact when the fuselage plug skidded across the surface, because the scratches were continuous across the span.

▶ **More Proof**—There was confirming evidence available. The electrical circuits of the Comet were in fair shape; only five fuses were blown, and the others were still untouched. Electrical system experts traced out the circuits and deduced the power had failed somewhere in the fuselage upper center.

More confirmation came from study of the seat failures. They showed that the seats failed first in a forward direction, and then in a backward direction. The forward failure was violent, and —postulated the engineers—was caused by the tremendous suction wave when the cabin failed. The second rearward failure was caused when the fuselage hit the sea, tail first.

▶ **Final Pieces**—By now Sir Arnold and his staff were fairly certain of the failure of the pressure cabin, and the subsequent breakup of the aircraft. It remained to locate the initial failure.

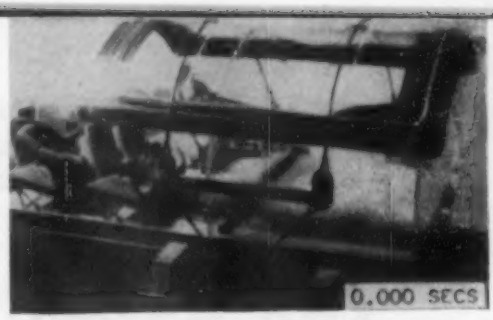
Again the scientists went back to the fuselage piece. Since it had blown out at a high velocity, might it not have been near or at the point of failure? The answer was to check the fuselage again. The final conclusion was the fuselage had failed at the region of the ADF "windows" in the top.

By then it was early July; Sir Arnold asked the Admiralty to reorient the search for wreckage with the hope of finding the missing fuselage sections. August 12th the sea gave up the ADF windows and the roof around them; but it was with a lot of other wreckage and nobody recognized it. By the time it got to Farnborough, August was ending.

But by the end of September, the RAE scientists had completed their fracture analysis of the area around the "windows" and they were sure of the area of initial failure.

▶ **Complete Analysis**—Now it was possible to reconstruct the last moments of life remaining to G-ALYP, high over the Romans' sea.

She was nearing the top of her climb, cruising steadily through the cold air. Forward, the crew was finishing the

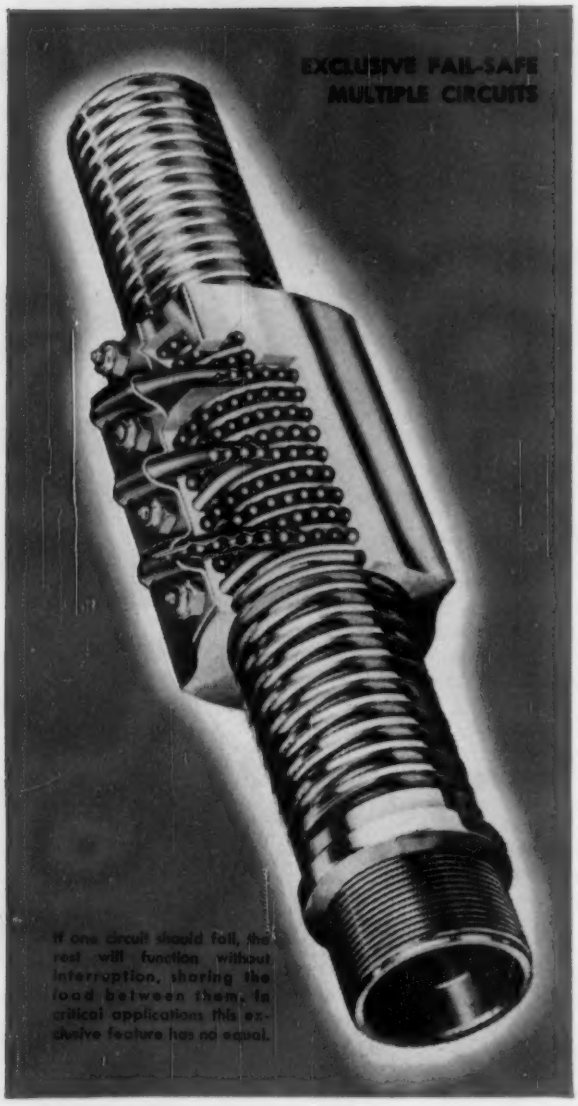


COMPLETE CHAOS exists inside cabin. Dummy passengers strike the roof, seats have torn loose and cabin is spewing out everything movable. Severe skull injuries were probably caused by this cataclysm.

WEIGHT, POWER OR

The Safety ball/bearing Screw

can help you solve them!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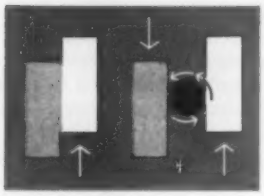
Safety ball bearing Screw

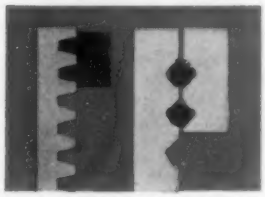
TEMPERATURE PROBLEMS?

WHAT IT IS AND HOW IT WORKS:

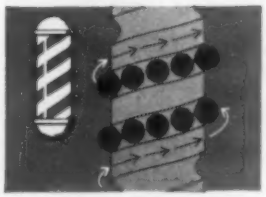
The Balls Go Round and Round and They Come Back Here!



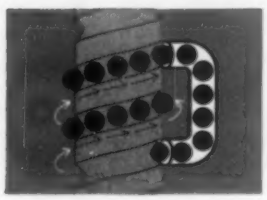
Let's start at the very beginning —with the familiar principle that there's far less friction in *rolling* than in *sliding*. The coefficient of sliding friction ranges from approximately .001 to .4—while the coefficient of rolling friction ranges from about .0005 to .003.



By applying this principle, the *Safety ball bearing Screw* radically increases the efficiency of rotary-to-linear (or linear-to-rotary) motion. Instead of *sliding* against each other, the surfaces of the screw and mating nut glide on rolling balls.

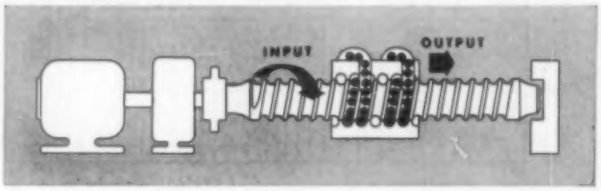


Like the stripes on a revolving barber pole, the balls travel toward the end of the nut through the spiral "tunnel" formed by the concave threads in both the nut and the screw.



At the end of their trip, one or more tubular ball guides constantly swallow the balls, lead them diagonally across the outside of the nut and back to their starting point. This forms a closed circuit through which the balls continually recirculate when the nut and screw are rotated relative to each other.

HOW IT CAN HELP SOLVE YOUR AIRCRAFT ACTUATION PROBLEMS



Compared with the conventional Acme screw's efficiency of less than 25%, the efficiency of the *Safety b/b Screw* ranges from *90% to 95%!* This makes it by far the most efficient known mechanism for translating rotary-to-linear motion, or vice versa. Combined with an electrical, hydraulic or pneumatic power source, the *Safety b/b Screw* forms an actuator with tremendous advantages for the aircraft engineer. For example, it can enable you to:

SAVE WEIGHT—compared to either Acme screw or hydraulic actuators, the *Safety b/b Screw* saves both weight and space by permitting use of smaller motors and gear boxes; eliminating pumps, accumulators, piping, etc.

SAVE POWER—by requiring only 1/3 as much torque as a conventional Acme screw for the same amount of lineal output, the *Safety b/b Screw* permits the use of much smaller motors with far less load on the electrical system.

SOLVE TEMPERATURE PROBLEMS—the *Safety b/b Screw* operates successfully at both extremely low and high temperatures, ranging from −75°F to +900°F—*without lubrication*, if necessary.

ASSURE POSITIVE POSITIONING—unlike some other types of actuators, the *Safety b/b Screw* permits precision control within thousandths of an inch, plus perfect synchronization of two or more movements.

INCREASE DEPENDABILITY—the *Safety b/b Screw* decreases combat vulnerability, offers the added security of *exclusive multiple circuits*, and reduces maintenance requirements because its "Gothic arch"-shaped races greatly decrease dirt sensitivity.

REDUCE PART AND INSTALLATION COSTS—in addition to all these design, operating and maintenance advantages, the *Safety b/b Screw* also cuts costs by permitting the use of smaller motors, decreasing power and auxiliary equipment requirements.

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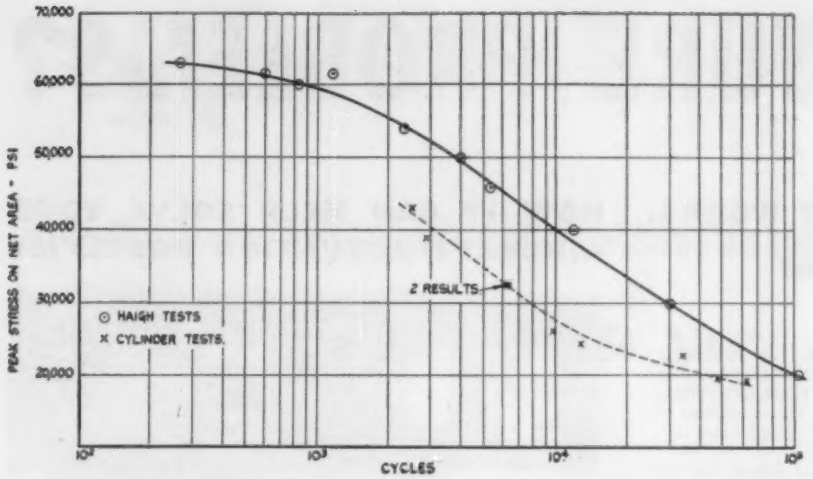
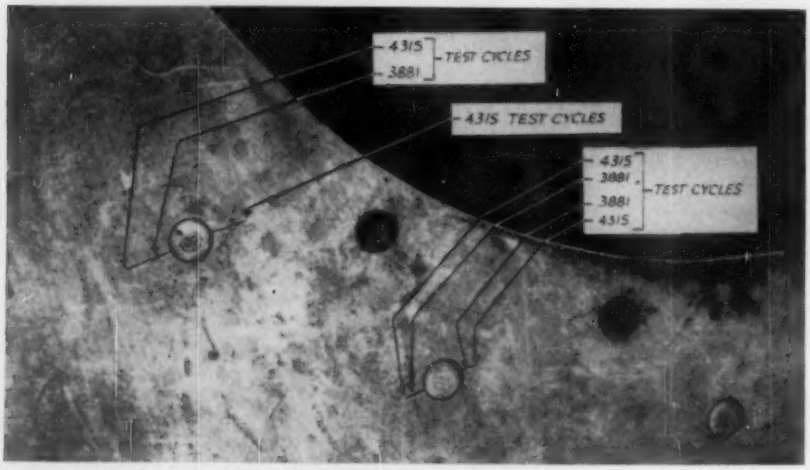
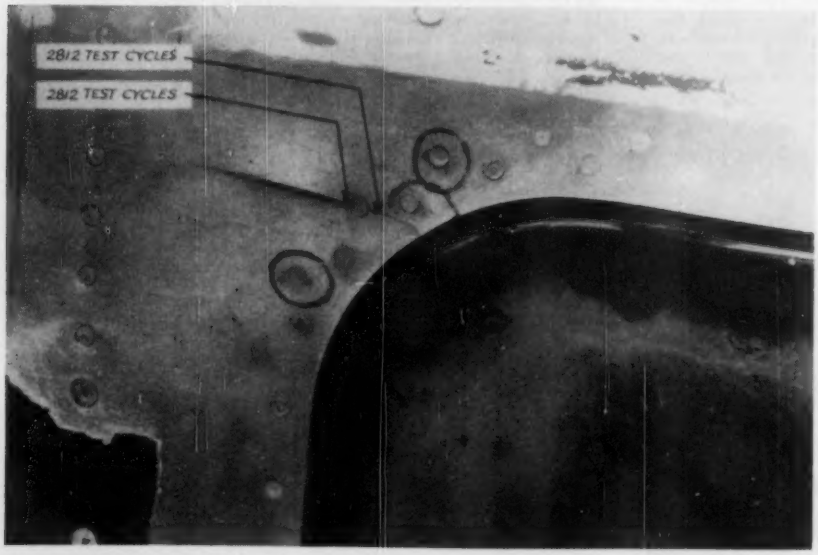


S-N CURVE for DTD 546 aluminum alloy used in Comets was established by three test programs: Small cylinders loaded with internal pressure (circles); small cylinders with stress varied from zero to maximum (solid line); 44-in. dia.-riveted structure built and tested by Saunders-Roe Ltd. for Ministry of Supply (dotted line).



SKIN CRACKS at rear bottom corner of Comet forward escape hatch, starboard side. Numbers refer to number of test cycles, should be increased by 1,231 for total cycles.



FATIGUE CRACKS at forward top corner of No. 2 window port side of Comet after 4,315 test cycles. Numbered points give indication of rate of crack growth.

last of its routine duties of the ascent. The pilot answered another BOAC scheduled flight, an Argonaut wanting to know the height of cloud tops. He spoke briefly with the Argonaut's captain; hearing no acknowledgment, he called back.

"GHJ from GYP," he said, "Did you get my . . ."

With an explosive roar and the shrieking of rent metal, G-ALYP's fuselage blasted open. First a large portion forward of the cabin blew out, then the major portion of the cabin roof.

Within three-tenths of a second, the cabin was cleared of everything movable. Seats, luggage, passengers were catapulted up and forward in a tangled mass. Death was instantaneous.

Still plunging forward under its tremendous inertia, G-ALYP swung to a near-vertical attitude. Wings and fuselage failed under the sudden, enormous air loads. The nose and tail of the fuselage separated; the wing broke into three pieces. The center section, now burning fiercely, snapped to an inverted position and slowly spiraled down through the thousands of feet to the water.

Before it, the fuselage nose and tail raced, open-end toward the water. They splashed; then the wing slapped the surface and sank. Nearby, two wingtips fluttered down, catching the midmorning light on their polished surfaces.

▶ **First Act**—That was the tragedy and that was how it happened. Within hours the Comet fleet was grounded and examinations begun. Fixes were made, and the fleet flew again.

The second tragedy happened early in April to Comet G-ALYY, climbing out of Rome to altitude, to be lost over sunny Naples.

The explanation for the first later was accepted as the explanation for the second by RAE technicians. Lacking any more positive evidence and faced with unrecoverable wreckage, there was no other course.

Besides, the tests of the submerged Comet were showing failures of fatigue. This, assuming both accidents to have been caused by fatigue, was a trend.

But how much of a trend? What kind of fatigue life would the Comets that remained be able to show? Was there any point in letting the rest of the fleet go back into service because—perhaps—the two that failed were rogues?

The answers to those questions were to be found under water, in the huge tank built to contain G-ALYU on its last flights.

▶ **Tank Tests**—G-ALYU had made 1,231 pressurized flights in BOAC service and now it began building up that total still further. It climbed over 1,600 more cycles before pressurization

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SUMMARY OF PRESSURISED FLIGHT CYCLES ON FUSELAGE

Total Number of Pressure Cycles to 8½ lb./in.²			Total Number of Gust Load Cycles		Total Number of Proving Tests to 11 lb./in.²		Remarks
Test Only		Total Including Flight History	Test Only	Total Including Flight History	R.A.E. Test	Total Incl. Flight History	
Without Gust Loads	With Gust Loads						
.....	0	1,231	0	30,000*	0	4	2 proving tests at de Havillands. 2 by B.O.A.C.
.....	0	1,231	100	30,100	1	5	Checking on wing cycling rig and on pressurisation rig. Proving test made.
.....	230	1,461	5,800	35,800	1	5	Inspection.
.....	596	1,827	14,600	44,600	1	5	Inspection.
.....	756	1,987	18,800	48,800	1	5	Inspection.
.....	1,260	2,491	31,300	61,300	2	6	Inspection. Proving test made.
.....	1,826	3,057	45,500	75,500	2	6	Inspection. Repairs after frame and skin failures in rear fuselage due to local overloading from applied fuselage load.
.....	1,826	3,057	45,500	75,500	3	7	Failure of front fuselage at 10.4 lb./in.² during proving test. Fuselage repaired and proving test made.
210	2,602	4,043	64,900	94,900	4	8	Inspection. Skin cracks at windows and casting failures at rear end of pressure floor.
210	3,671	5,112	91,600	121,600	4	8	Further skin cracks at windows.
210	4,105	5,546	102,400	132,400	4	8	Failure of rear fuselage.

* *Estimated equivalent of 3,539 hours operational flying.*

leaks began to show. But the cabin integrity still held.

Then without advance warning, the fuselage failed. An eight-by-three hunk of structure ripped out of the rear fuselage. Initial failure was traced to a fatigue crack in the skin at the lower rear corner of an escape hatch.

The fuselage was repaired with a new panel, and some of the skin cracks around other windows were "fixed" with external doubler plates riveted to the skin. At this stage, and largely because of the localization of the failures around the windows, strain gages were installed in carefully located positions at window corners.

The next test was for proof of the repaired structure; the pressure was blown up to 11 psi., then down to the test value and cycling continued. At 3,833 cycles the wing was damaged by fatigue, enough to call a temporary halt for repairs. The next 210 cycles were pressurization only, without the extra loading of gusts on the wings. Then both gusts and pressure loads were applied to a total of 3,891 "flights," at which time a large crack appeared at a window.

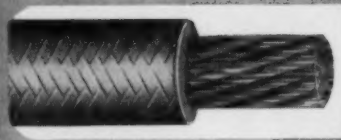
The final failure was spotted as an incipient crack after a total of 4,255 test cycles. It was then about 1 in. long, extending from a rivet hole at the forward bottom corner of No. 7 window. It grew rapidly aft to the edge of the skin and forward almost 5 in.

Then at 4,315 test cycles the fuselage ripped out in a large section between frames 26 and 34 (about 15 ft. distance). This was the end of G-ALYU.

► **Gages and Loadings**—The strain gages told the story of stress distribution near the corners of the windows. For the worst cases, this is how the loading broke down:

• **Cabin differential pressure** gave a

specify LEWIS
high temperature and
moisture resistant
aircraft electrical cable
for critical circuits
to USAF specification 32659



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For design of aircraft test models for aerodynamic, aeroelastic and flutter testing. Requires knowledge of instrumentation techniques and familiarization with model requirements for representative low and high speed wind tunnels. Minmium of engineering degree or equivalent plus one year of direct experience.

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For Preliminiary Design Analysis —necessary experience must include background in integrating radar, fire control, and other electro-mechanical systems. To do analytical-mathematical type of work for new aircraft proposals.

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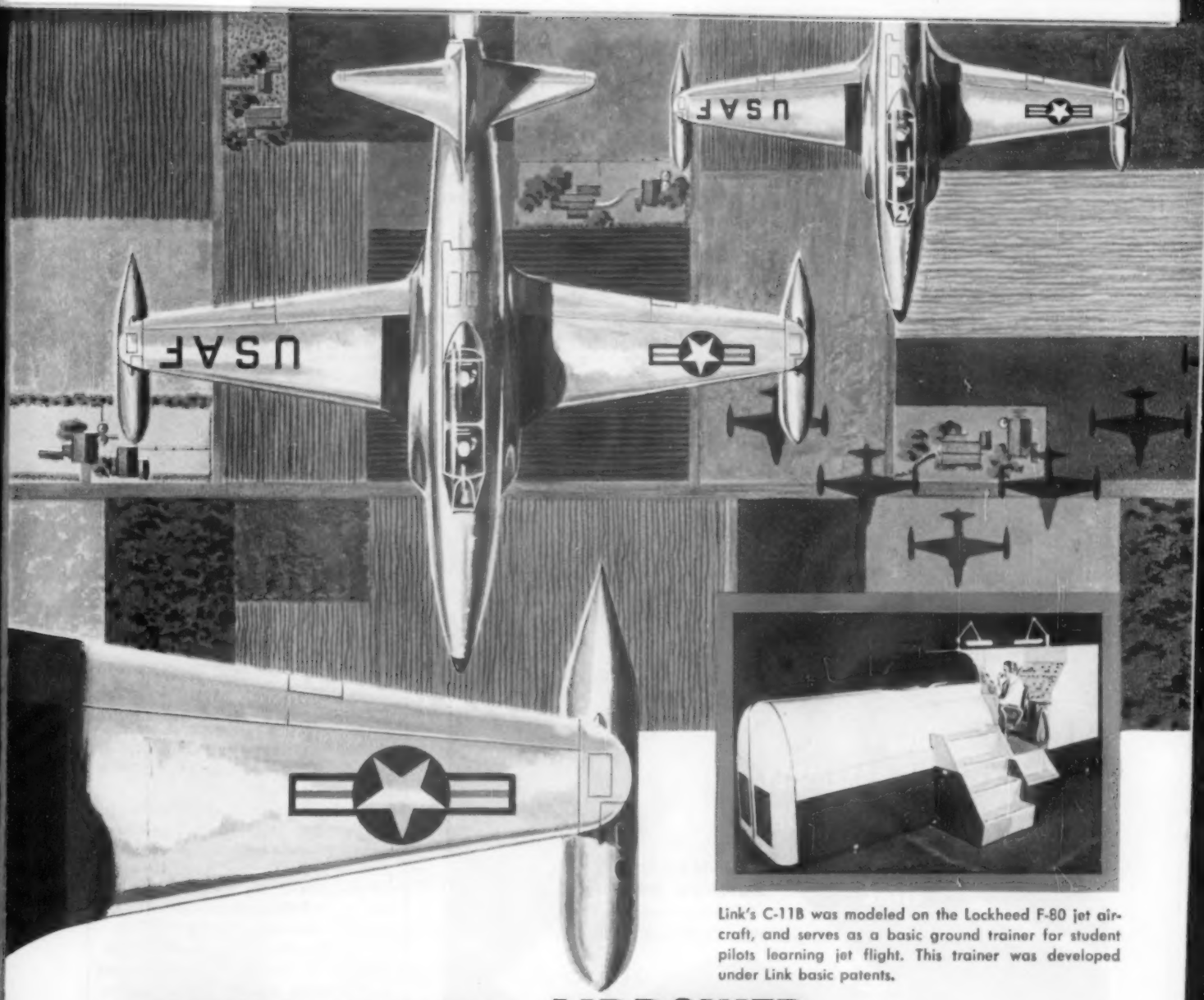

Link's C-11B was modeled on the Lockheed F-80 jet aircraft, and serves as a basic ground trainer for student pilots learning jet flight. This trainer was developed under Link basic patents.

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THE C-11B, through its reproduction of the many conditions of jet flight, is giving our fighter pilots realistic training in all phases of single-jet flying—from the pre-takeoff inspection right through to an instrument landing.

THE C-11B is also used by veteran jet pilots to help them maintain peak proficiency in the performance of their vital assignments.

This is one of the many ways in which Link helps pilots keep pace with the rapid development of jet aircraft in America.

LINK INVITES APPLICATIONS FROM QUALIFIED ENGINEERS AND DRAFTSMEN.

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Manufacturers of world-famous Link trainers and simulators (such as F3D, B-47, F-89, F2H-2, F2H-3) • simulated aircraft instruments specialized computers • servo mechanisms • computer components gear boxes • friction over-drive clutches • precision potentiometers ratio voltmeters • phase angle meters • and other electronic devices

stress which reached 43,100 psi.

• **Difference between flight loads and ground loads** gave a stress additive of 650 psi.

• **Gust loadings** produced an additional stress of 1,950 psi.

• **Total maximum stress** is the sum of those three, or 45,700 psi.

In practice, said the RAE, this figure would be reached two or three times per flight. It represents about 70% of the ultimate stress of DTD 546, the aluminum alloy forming most of the Comet.

There was one more reservation. The scientists noted that rivet holes were some distance from the points of maximum stress as found by strain gages. But they knew that rivet holes are stress-raisers too localized to be picked up by strain gages. Thus they concluded that it was possible that stress at a rivet hole would be somewhat higher than 70% ultimate.

The strain gages showed one other loading characteristic clearly: The cabin pressure loads in the region explored predominate by a large margin over flight and gust loads considered important from aspects of fatigue.

▶ **Wing Failures**—The wheel well skin was the first place that wing cracks showed. On the starboard side, a crack extended to 8¼ in., of which 2½ in. had been produced in only two loading cycles. This stopped the tests temporarily for a fix.

Further cracks later appeared at spar wing gusset plates and were repaired. Between 10,000 and 15,000 equivalent hours of flight, the bottom skin was laced with tiny cracks.

Said the RAE report: "On the evidence of the test alone, the Comet would appear to have been as much in danger from wing fatigue as from pressure cabin fatigue."

There was a final consideration of the accuracy of the tests and the results, caused primarily by errors in loadings.

To quote the RAE report again:

"Gust and general flying loads, which are represented in the tests, are shown by the strain gage results to be secondary in their effects. Any errors in their representation, therefore, are unlikely to have serious effects on test results, but such as they are indicate

Maximum Effort

There was no single agency which, in the final sense, solved the Comet mystery.

RAE, asked to investigate the wreckage and to ascertain the possible causes, was one of many groups of specialists called in a time of tragedy.

The engine analysis, which confirmed their integrity at the breakup and supported RAE's hypothesis of a violent pitching at that instant, was done under the direction of Dr. E. S. Moult, chief engineer of DH's engine company, at the company's factory.

P. G. Tweedie, chief inspector of accidents for the Ministry of Transport and Civil Aviation, and his staff invesigators proved invaluable during the salvage and the subsequent examinations.

There were others whose investigations and help, small and large, aided the final conclusions. An Italian farmer, a Harley St. pathologist, a Maltese seaman played important roles as the drama ran towards its end.

But in retrospect, it is the brilliant work of RAE that stands out, perhaps because the scientists played the role of Holmes to the others' Watson, or perhaps because their work was the final assembling of the technical pieces.

But whatever the reason—objective or subjective—there will be no argument that the work done was truly "one of the most amazing pieces of scientific detection. . . ."

The work of the tireless staff of the Royal Aircraft Establishment at Farnborough will stand as the highest symbol of the professional standards and integrity of the engineering profession.

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The case entails a complex, close tolerance sheet metal stamping and forming operation. This fabrication saved an estimated 30% in weight over an extruded junction box previously contemplated. Time-lag between concept and final assembly was materially reduced.
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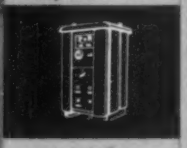

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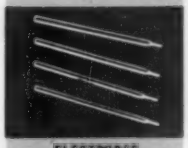
Four sizes—200, 300, 400, and 500 amps.



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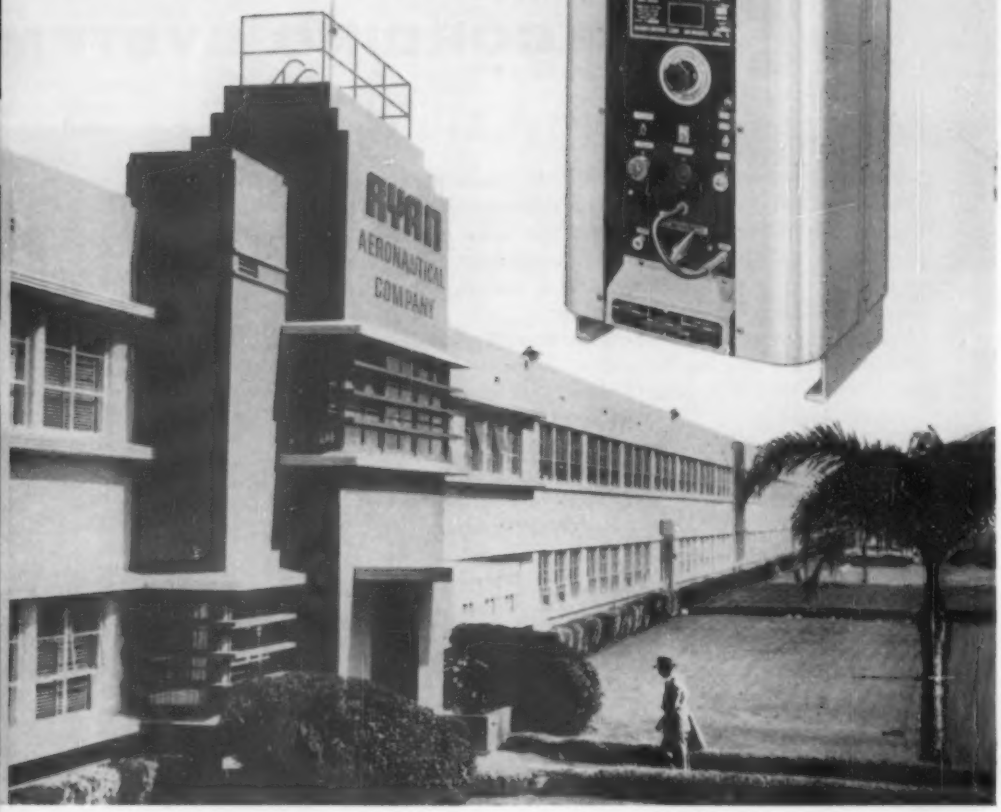
P&H High Frequency AC Welder of the type used at Ryan.



They're welding titanium down to .016" at Ryan Aeronautical Company

P&H Welders, with their instantaneous remote control and wide welding range, make this tough job easier

When you have a tough material to weld such as aluminum, titanium or special alloys, P&H high frequency welders, AC or DC, really come into their own.

You see, P&H welders have what we call Dial-lectric control. It's an exclusive feature that provides instantaneous heat control right at the work. There are no moving coils or cores, no wheels to turn—no time lag.

In addition, P&H welders have an extremely wide range. On one of our models for example, you can go all the way from 475 amps down to 2 amps.

But we were talking about titanium — a tough material to weld in anyone's language. Here's what they say at Ryan where they use P&H high frequency machines, "There is less of a problem welding titanium than many users have been led to believe. With titanium we can go to any degree of thinness on material so far available. We have been down to .016" on this vital material." May we add again that it's P&H positive heat control and wider range that makes such a performance possible.

If you have tough welding jobs to do . . . if you wish to boost production and cut costs, standardize on P&H welders. Ask your P&H representative or distributor for all the facts. Or write for latest bulletins.

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that the true life should be somewhat

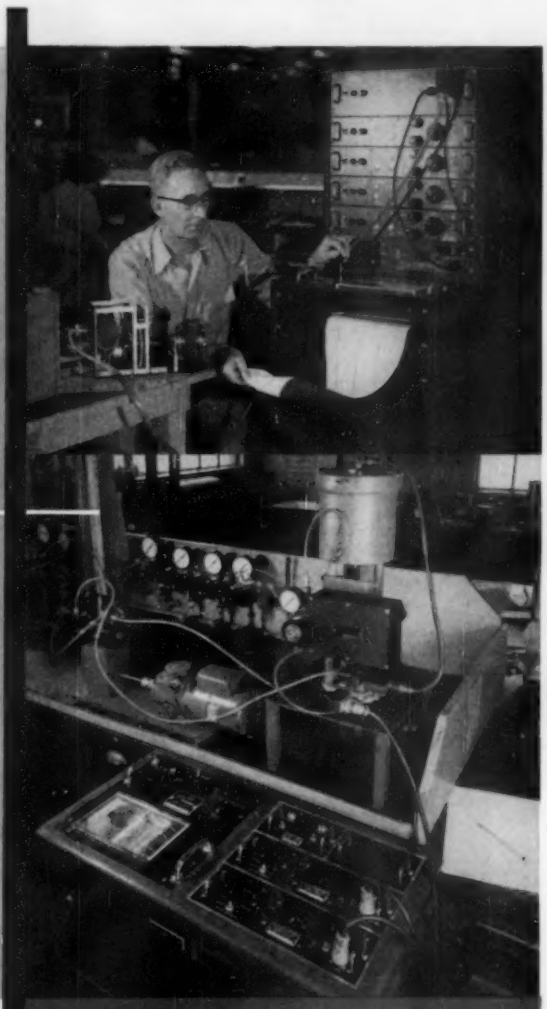
How two TYPICAL production testing headaches were cured with SANBORN OSCILLOGRAPHIC RECORDING SYSTEMS

RAYTHEON MANUFACTURING COMPANY'S Waltham, Mass. Inspection Dept. formerly found their incoming inspection of complex, multi-ganged potentiometers a time-taking and costly job which involved tedious calibration, instrument set-up and testing for *each* of the five potentiometer sections, with each operation subject to inevitable human error.

Today, by using a Sanborn four-channel Recording System and a Potentiometer Power Supply, a visual, concurrent strip-chart record of *five* channels (using marker stylus) of phenomena such as phasing, shorting bar, winding noise, and resolution of winding turns is provided. Inspection time is speeded up 900%, the operator sees immediately all causes for rejection, the chart is a permanent test data record, one inspector takes the place of three, and human error is reduced to a negligible factor.

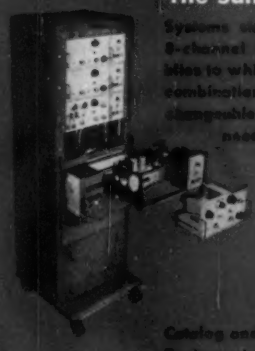
MOORE PRODUCTS COMPANY of Philadelphia uses a Sanborn Model 60 two-channel Recording System to check the Dynamic Performance of their Valve Positioners, which are used on diaphragm top-work valves and power cylinders. The valve positioner acts as a relay, applying additional air pressure to the cylinder or top-work, overcoming effects of unbalance and friction, and compelling the valve stem to take the position dictated by the pneumatic controller or manually-operated air load. A feed-back linkage assures positioning of the valve stem within plus or minus 0.001".

A pneumatic sine wave generator supplies pneumatic impulses with frequencies as high as 20 cycles per second. These impulses are sent to the valve positioner and to a transducer which converts the signal for the recorder. The response of the valve stem is measured by a strain gage pickup for the second channel of the recorder.



The above cases are but two of the many applications possible with Sanborn one-, two-, four-, six- and eight-channel Recording Systems. With a Sanborn you can register permanently and graphically virtually all electrical phenomena within a frequency range of zero to 100 cps. A choice of the number of channels, plus the ready interchangeability of various type preamplifiers (to meet individual recording problems) offers a wider versatility of use, greater overall economy, and increased operating efficiency.

Added to these advantages are the standard SANBORN instrument features: INKLESS recording in true rectangular coordinates, high torque galvanometer movement, time and code marking, and numerous paper travel speeds.



The Sanborn "150" Series

Systems start with 1-, 2-, 4-, 6- or 8-channel Cabinet-Recorder Assemblies to which the user adds whatever combination of the following interchangeable plug-in Preamplifiers is needed for his work.

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- Carrier
- Servo Monitor
- DC Coupling
- Log-Audio
- Low Level Chopper
- Input Network

Catalog and Technical Data on "150" Equipment available on request.

SANBORN COMPANY

INDUSTRIAL DIVISION

CAMBRIDGE 39, MASSACHUSETTS

that the true life should be somewhat less than that obtained in test.

"There are, however, other effects which could not be reproduced. First, there is the fluctuation of cabin pressure during an actual flight, which cannot entirely be avoided in practice, owing to practical engineering limitations of pressure control equipment. Secondly, there are vibration stresses caused by engines, which are superimposed on the pressure loads. Thirdly, there is the additional stress produced in the cabin shell by contraction through low temperature at high altitude.

"None of these effects has yet been assessed accurately for its effect on fatigue life. In all cases, however, they are almost certainly detrimental in some degree. The conclusion is, therefore, that the life under operating conditions would be less than test results indicate."

▶ **Scatter**—The test Comet showed a fatigue life approximately three times that of either lost Comet. RAE was familiar with this phenomenon, because it has long been known that there are no two airplanes built exactly alike, that would fail at the same stress level or same number of repeated load cycles.

The important question was: Is a three-to-one spread what would be expected?

Yes, said Dr. Walker, RAE's structures chief. In fact, nine-to-one is the kind of number you might think of in the case of fatigue. It would have been nice to have the time and facilities to test about six more airplanes to establish the spread for the Comet, but that was not possible.

That was about the last scientific opinion needed to complete the investigation. Later in the formal hearings there would be questions and answers. Walker's findings, Hall's deductions, Ripley's reconstruction of the wreckage were to be questioned. But the ultimate analysis was to stand.

"We have formed the opinion that the accident at Elba was caused by structural failure of the pressure cabin, brought about by fatigue."

Fast Detector Spots Explosive Mixtures

A new gas detector, used in spotting explosive accumulations caused by firing aircraft guns, is also applicable to sensing many types of combustible gas. Measurement and control range of the electronic device is 10%-100% of lower explosive limit, time response is less than one-half second. Unit can operate from —40 to 60C.

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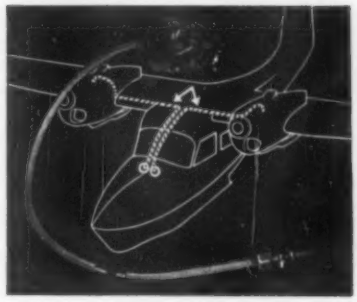
As shown by the illustration, completely dependable, trouble-free mechanical connections between wing-mounted aircraft engines and their respective tachometers are provided by two S.S.White power drive flexible shafts. No difficulties are experienced in installing the flexible shafts along wing and fuselage contours or around intervening struts and frames.



IT PAYS TO THINK
OF FLEXIBLE SHAFTS

For transmitting rotary power or remote control, S.S.White flexible shafts offer distinct advantages. Why not consider their use on your own applications?

A large selection of sizes and types are available to meet a wide range of requirements.

P-3

BULLETIN 5306 gives details on how to select and apply flexible shafts. Send for your copy. Address Dept. V.

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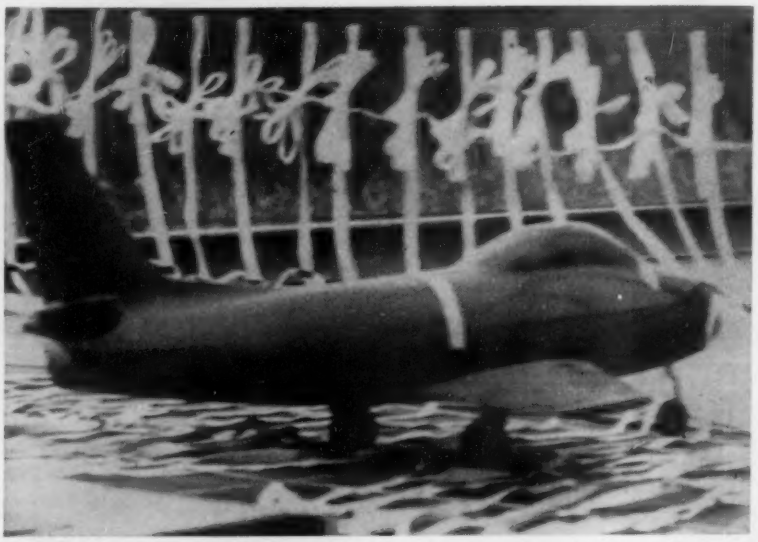
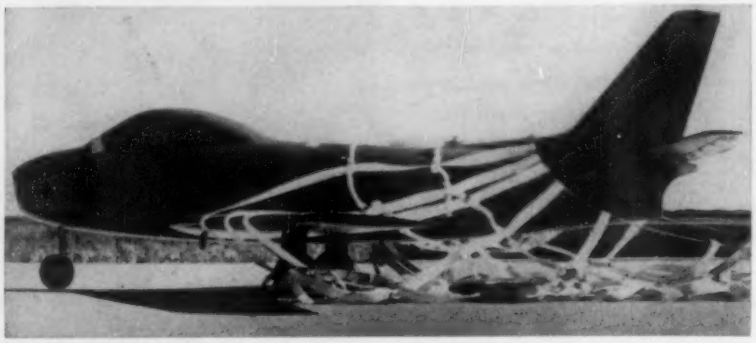
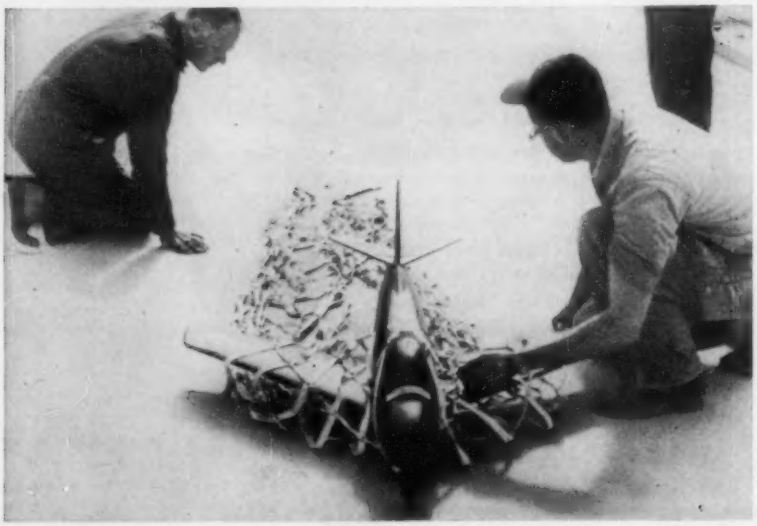
Jet Models Test Safety Net



MODEL F-86 is catapulted into 1/10-scale nylon barrier to simulate real action. Tests are being made by All American Engineering Co., Wilmington, Del.



SNARED MODEL shows how barrier can halt planes from overshooting runway. Early barriers were used in Korean war (Aviation Week June 15, 1953, p. 18).



ALL AMERICAN TECHNICIANS study results of test run. Company has AMC contract to design and fabricate similar barriers for new U. S. Air Force highspeed jets.

IAS Summaries

• More than 1,500 attend 23rd annual meeting of Institute, hear 80 papers at New York gathering.

More than 1,500 engineers, scientists and technicians of the aircraft industry registered at the 23rd annual meeting of the Institute of the Aeronautical Sciences, January 24-27, in New York City.

The four-day meeting featured 22 technical sessions on the problems and progress of today's highspeed aeronautical world, with significant attention being paid to aerodynamics and aeroelasticity.

About 80 papers were presented to the Institute in as many as seven meetings during a single day.

Here is the first of a series of abstracts of the papers presented during the sessions. These abstracts were made available to AVIATION WEEK by the Institute of the Aeronautical Sciences.

Aerodynamics

▶ Dynamic Derivatives in Yaw and Sideslip of Thin Wings at Supersonic Speeds.—Theodore R. Goodman Aerodynamic Research Dept., Cornell Aero. Lab., Inc.

There are three lateral dynamic attitudes, delineated by rolling, yawing, and sideslipping. It is possible to solve for the pressures on the rolling wing by quasi-steady analysis. This approach is, however, inapplicable for the yawing or sideslipping wing, and it is with the latter two cases that this paper deals.

Two linear combinations of rolling and sideslipping are considered. In the first, sideslipping is zero (circular flight path), and for this case the pressures are found on an infinite swept wing. In the second, sideslipping and yawing are equal (straight flight path; turning wing), and for this case general formulas are derived for wings with an arbitrary supersonic leading edge, and also for wings with a subsonic leading edge adjacent to a supersonic edge. The rolling moment associated with the latter motion has been determined for a number of useful planforms.

▶ Base Pressure Studies in Rarefield Supersonic Flows.—L. L. Kavanau, Research Engr., Missile Systems Div., Lockheed Aircraft Corp.

Base pressures were measured on a simple cone-cylinder configuration over a range of Mach numbers and Reynolds numbers based on model length. The final results indicated that the base pressure decreased with decreasing Reynolds number and increasing Mach number which was attributed to the completely laminar character of the boundary layer and also to the critical wake region.

Preliminary tests showed a considerable variation of pressure existing over the base

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Whatever the job . . .

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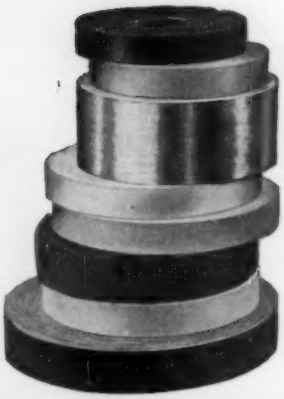
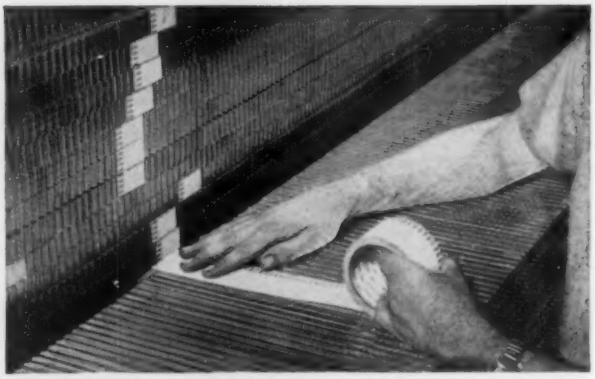
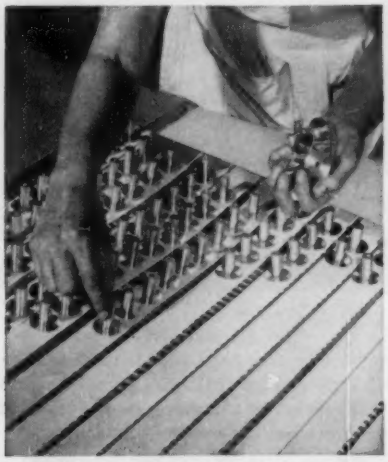


ECONOMY IN PRODUCTION of the Martin Matador, new pilotless bomber, is the result of new techniques in which Permacel Tapes are used for a wide variety of cost and time saving applications.



HONEYCOMB "LUMBER" of aluminum, used in new adhesive bonding technique, is marked by Permacel 725 Printed Tape with part No. identification prior to being sawed into various size panels.



PERMACEL 77 Crepe Paper Masking Tape, adhesive side up, holds light-weight aluminum thimbles for adhesive spraying.

ELECTRICAL TERMINALS insulated with Permacel 30 Heavy Duty Plastic Tape for exceptionally high dielectric strength.

"FLYING COLORS" for all aircraft quickly, easily—by masking paint jobs with Permacel 71 Stain-Resistant Masking Tape.

SELF-STICKING

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area, thus requiring an area-mean determination of the base pressure for every flow condition. Investigations were made of support interference effects arising from the relative size of both the sting diameter and sting length as compared to the model diameter. Some effects due to heat transfer were also studied. Supplementary pressure distributions were taken on the model surface upstream of the base and in the wake at one Mach and Reynolds number which was characteristic of this flow regime. The base pressure coefficient in free molecule flow is calculated for comparison purposes.

A discussion is presented of these results together with experimental and theoretical works of other investigators.

▶Free-Flight Measurements of Skin Friction of Turbulent Boundary Layers with High Rates of Heat Transfer at High Supersonic Speeds.—Simon C. Sommer and Barbara J. Short, Ames Aero. Lab., NACA.

The average skin friction of a turbulent boundary layer in the presence of severe aerodynamic heating has been measured in the Ames Supersonic Free-Flight Windtunnel on free-flying, hollow-cylinder models at Mach numbers of 2.8, 3.8, 5.6, and 7.0.

The skin friction measured under these conditions is appreciably higher than the skin friction measured on surfaces having zero heat transfer, experimentally confirming the trend of theoretical estimates of the effect of heat transfer on skin friction. It was found that the high heat-transfer skin-friction data of the present investigation at Mach numbers up to 7, the zero heat-transfer skin-friction data obtained in previous windtunnel investigations at Mach numbers up to 4.5, and the skin-friction data for heated pipe flow at subsonic speeds were in excellent agreement with the predictions of the T' method of Rubesin and Johnson, slightly modified for turbulent boundary layers.

On the basis of this broad scope of agreement, the modified T' method appears to be the best available method of predicting skin friction of turbulent boundary layers at test conditions where no data exist.

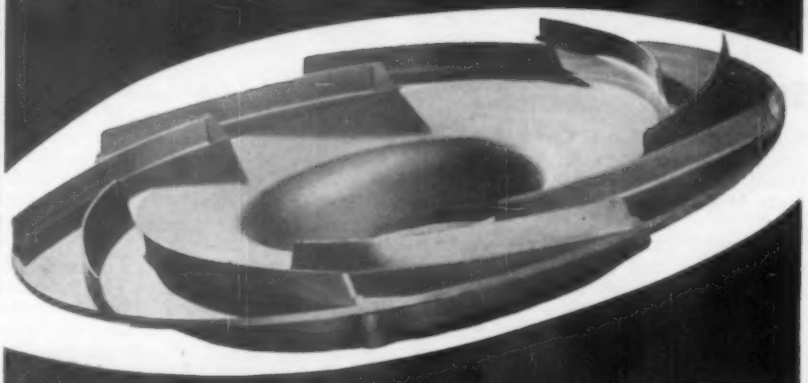
▶Fluid Dynamic Effects at Speeds from M = 11 to 15.—Seymour M. Bogdonoff, Assoc. Prof., and Andrew G. Hammitt, Research Assoc., Gas Dynamics Lab., Princeton University.

The phenomena of viscid-inviscid interaction effects at very high speeds over the fore part of bodies has been studied at speeds considerably higher than those previously investigated. A tunnel, using helium as a working fluid, has been developed for these studies and has been operated at speeds up to M = 15. Increases in the speed up to M = 20 seem quite possible with further development.

Pressure distributions have been obtained over the fore part of some simple bodies; a flat plate, two wedges, and a cone. In addition, Schlieren and interferometric photographs have been taken. The results show that extremely high pressures, as high as 10 times the values predicted by inviscid theories, are obtained over the region close to the nose of the body.

Although some aspects of theoretical work on this problem appear to be correct, the numerical values of the pressures obtained are considerably different than predicted.

Lycoming and Rolle solve another casting problem . . .



CASTING COSTS DOWN 44.5%
...MACHINING TIME CUT 50%

PROBLEM: The aluminum diffuser plate illustrated was originally cast in sand for Lycoming Division of AVCO Mfg. Corp., Stratford, Conn. Despite painstaking foundry work in an attempt to meet finish requirements and close dimensional tolerances, limitations of the casting process made expensive hand buffing necessary in the area between vanes.

SOLUTION: To reduce the amount of buffing needed, Rolle foundry engineers recommended a change from sand to permanent mold casting methods. Following customer approval, a mold was designed by Rolle's permanent mold division to produce castings with a guaranteed surface in the required areas of from 100 to 125 microinches. It was also predicted that the change in casting method would improve metallurgical soundness, and permit higher production rates, at a lower over-all cost.

RESULTS: Fine surface finish of the permanent mold cast diffuser plates has almost eliminated costly hand buffing. And uniformly close dimensional tolerances have so simplified location of machining positions from fixed points on the casting surface that tooling has been redesigned and greatly simplified to provide even further savings.

In all, Lycoming engineers report that this one recommendation by Rolle casting experts has reduced the cost of each casting 44.5% . . . and cut the time needed to machine each casting in half.

YOUR CASTING PROBLEMS . . . whether they involve sand or permanent mold casting of aluminum or magnesium alloys . . . can always be solved quickly and economically if you bring them to Rolle.

Write for free booklet that tells how you can

PERTINENT DATA	
Diffuser plate for reciprocating engine supercharger.	
Alloy	Aluminum 355
Temper	T71
Weight	9 lbs.
Diameter	18"

Fight weight with strength

with ROLLE

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on the order of two or three times as large. This difference may be explained by the influence of the leading edge and some preliminary results on this effect are presented.

Structures

▶The Matric Solution of Certain Nonlinear Problems in Structural Analysis.—Paul H. Denke, Strength Analysis Methods Engr., Santa Monica Div., Douglas Aircraft Co., Inc.

The matric formulations of the equations of equilibrium and of the Maxwell-Mohr equations of continuity are applied to the solution of certain nonlinear problems in the analysis of indeterminate structures.

Only nonlinearities in the elements of the flexibility matrix are involved in the class of problems under consideration. Such problems are characterized by the dependence of the flexibility matrix upon the internal loads. Nonlinearities resulting from plasticity and from certain types of buckling have this characteristic.

The analysis is applied to a simple indeterminate structure in which the members are considered to exhibit first, plasticity, and second, buckling. The highspeed digital computer is utilized in solving the nonlinear matric equations.

▶Design of Structural Models With Application to Stiffened Panels Under Combined Shear and Compression.—P. E. Sandorff, Assoc. Prof., Aero. Engrg., MIT (Formerly Research Specialist, Lockheed Aircraft Corp.).

Practical methods for the design of structural test specimens are presented, based on the principle of exploring a specific mode of failure rather than the customary indefinite investigation of structural behavior in general.

This approach makes possible considerable simplification in specimen construction, through application of similitude relations, without introducing unknown restrictions on the validity of the results. Illustration is provided by application to the problem of interaction relations for stiffened-skin panels under combined compression and shear.

Results of full-scale tests, under simultaneous bending and torsion, of a box beam structure incorporating machined integrally-stiffened test panels substantiate the interaction curve derived by similitude relations.

▶Elasto-Plastic Bending of Beams on Elastic Foundations.—Paul Seide, Research Engr., Struct. Research Sect., Northrop Aircraft, Inc.

A comparison is made of two methods of solution of the bending of elastically supported beams of a material having a bi-linear stress-strain curve. One method involves the numerical solution of the fourth order non-linear differential equation associated with the engineering theory of bending of the plastic region of such beams. The other linearizes the problem by replacing the non-linear moment-curvature diagram by its asymptotes.

An infinite rectangular beam subjected to a concentrated load is examined in detail. The approximate method is found to be less time consuming and to yield results in very good agreement with those of the more accurate analysis. Finite beam deflections computed by means of the linearized theory are shown to be in good agreement with experiment.

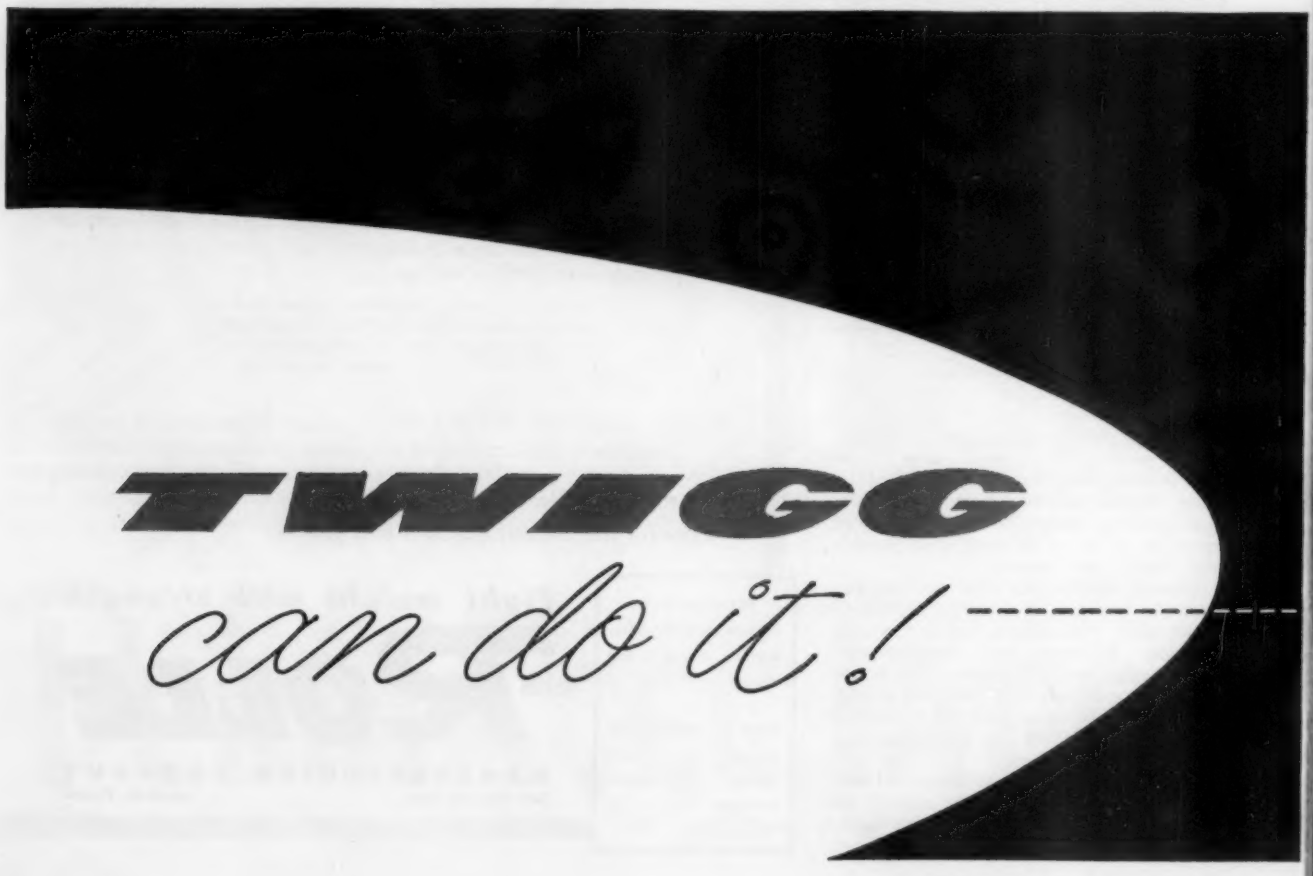
Stability and Control

▶Automatic Feedback Control and All-Weather Flying.—F. D. Graham, Asst. Chief, All Weather Branch, and Major Richard C. Lathrop, Chief, Measurements and Analysis Sect., All Weather Branch, Directorate of Flight and All Weather Testing, WADC.

A large part of the difficulty of operating aircraft in adverse weather revolves around precise control of the flight path in the absence of visual reference to objects outside the cockpit.

The inherent powerful advantages of high-gain automatic feedback control can be applied to the solution of this problem. These advantages are, however, attended by disadvantages, such as the tendency toward dynamic instability and a susceptibility to spurious signals or "noise." A successful match of the elements in an automatic feedback control loop is dependent on detailed knowledge of the mechanics—particularly the dynamics—of each element in the loop.

Existing theories are not always an adequate basis for this knowledge, and an extensive program of experimentation is required. Examples from the experience of the All Weather Branch are cited to illustrate how a knowledge of the mechanics of aircraft response to control, automatic pilots,



radio aids, and radar references is developed through flight research.

▶NACA Applications of Variable-Stability Airplanes to Lateral-Stability Research.—William M. Kauffman, Aero. Research Scientist, and Fred J. Drinkwater III, Aero. Research Pilot, Ames Aero. Lab., NACA.

Equipment developed at Ames Aeronautical Laboratory for varying in flight the lateral and directional stability characteristics of two fighter-type airplanes is described briefly. Emphasis is given to the research-tool possibilities offered by variable lateral-directional stability derivatives and associated lateral-oscillation characteristics.

Flight studies utilizing this equipment to identify important flying-qualities problems and to establish related design requirements, particularly with regard to oscillatory behavior, are discussed qualitatively. Various difficulties inherent in flight research of this type are noted.

Use of these variable-stability airplanes to simulate, for the benefit of company test pilots and designers, unusual lateral-directional stability characteristics predicted for prototype airplanes is discussed. Example problems and associated flight-test techniques involving high adverse roll due to rudder and very low directional stability are described.

The ready adaptability of these variable-stability airplanes to flight studies of the effectiveness of yaw dampers and similar stability-augmenting devices is pointed out, and results of brief flight tests of this type involving a promising nonlinear roll-damping modifier are presented.

Aeroelasticity

▶An Investigation of the Flutter Characteristics of Compressor and Turbine Blade Systems.—Chi-Teh Wang, Prof., Frank Lane, Research Assoc. Prof., and Robert J. Vaccaro, Research Assoc., Aero. Engrg. Dept., NYU.

As a first phase of a general research program, theoretical and experimental investigations have been carried out on the flutter characteristics of compressor and turbine blade systems in incompressible flow at low incidence.

It was found that, in the theoretical treatment of fluttering blade systems, the prohibitively larger number of the degrees of freedom necessary to analyze a multi-blade system can be greatly reduced by recognizing the existence of a single equivalent blade, thus permitting the actual carrying out of a flutter calculation. As examples, numerical calculations are made on two-dimensional unstaggered as well as staggered cascades. From these calculations, several interesting results are obtained.

First, for unstaggered cascades, the calculation shows this flutter occurs with adjacent blades oscillating 180° out of phase thus confirming the experimental observations by Lilley.

Secondly, it was found that for staggered cascades a very small change in blade inertial properties may cause a complete change of the blade flutter mode from one in which bending predominates to one in which torsion predominates.

To check the theoretical results, an experimental program is carried out at the same time. A flutter mechanism with two-degrees of freedom was designed and constructed for the testing of a two-dimensional cascade at low speed. The experimental results obtained checked very well with the theoretical findings.

▶Aerodynamic Influence Coefficients for an Oscillating Finite Thin Wing in Supersonic Flow.—Ta C. H. Li, Lead Aeroelastic Engr., Dynamic Analysis Gr., Chance Vought Aircraft, Inc.

A study, based on linearized theory, is made of the airforces of flexible thin wings oscillating harmonically in supersonic flow.

A method for calculating the airforces is proposed. This method approximates the airforces by dividing the region of integration into a mesh of congruent rectangles with diagonals parallel to the Mach-lines. The integration is carried out exactly spanwise and approximately chordwise.

A set of simple formulas for the influence coefficients is given which can be handled conveniently by any type of highspeed computer.

For subsonic leading edges, an imaginary diaphragm is considered to be in front of the leading edge, and linear equations expressing the condition of zero pressure difference off the wing are solved. The proposed method is then applied. Tips are treated in a similar manner.

Results for the two-dimensional case are in good agreement with those obtained by Garrick and Rubinow for M = 10/9, 5/4, 10/7, k up to .4, and are in excellent conformity with those of Temple and Jahn for M = 1.6, k up to .8.

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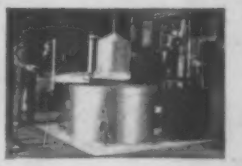

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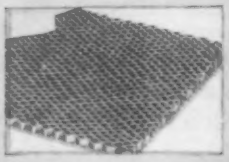

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WHAT'S NEW

Telling the Market

For All Your Broaching Needs is brochure showing engineering and manufacturing facilities of Detroit Broach Co., also illustrating some of their products. Write the firm at Rochester, Mich. . . . **How Plaster Molds Cuts Your Costs** is pocket-size booklet explaining economies of using this technique in pilot or limited runs. Available from Hale Foundry Co., 1680 Fall St., Cleveland, Ohio.

Selection of Carboloy Grades and Suggested Speeds is booklet designed to aid in picking cemented carbides for use as cutting tools for particular jobs. Write Carboloy Dept., General Electric Co., Detroit, Mich. . . . . **Miniature vibration isolators** are fully covered in Bulletin 542, obtainable from Barry Corp., 1000 Pleasant St., Watertown, Mass.

Recording charts for standard and special instruments are described in catalog available from Technical Charts, Inc., 189 Van Rensselaer St., Buffalo 10, N. Y. Over 8,000 types are covered. . . . **Cold-flow operations** such as riveting, swaging, flaring, reducing, dimpling and needed machines are described in booklet, To Bring You Up-to-Date on Airflex, which can be obtained from Lemert Engineering Co., Inc., 206 E. Jefferson, Plymouth, Ind.

Abrasive blasting machine employing tumbling principle and having 17.5-cu. ft. capacity is described in Bulletin 124-B available from American Wheelabrator & Equipment Corp., 1001 S. Byrkit St., Mishawaka, Ind. . . . **Arcon automatic rudder control system** for counteracting airplane directional instability is fully covered in brochure being distributed by LearCal Division, Lear, Inc., 3171 S. Bundy Dr., Santa Monica, Calif.

Standard line of worm gears sets for equipment with shock load or uniform load characteristics is described in Engineering Manual SW No. 1. Write to Foote Bros. Gear & Machine Corp., 4545 So. Western Ave., Chicago 9. . . . **Latest copper and alloy specs,** including ASTM, ASME, SAE, AMS, Federal, Military, Army, Navy and Joint Army-Navy, are listed in indexed Anaconda Publication B-34R. Write American Brass Co., Waterbury 20, Conn.

How to Operate a Lift Truck is two-color sixth edition of booklet slanted for both engineers and experienced op-

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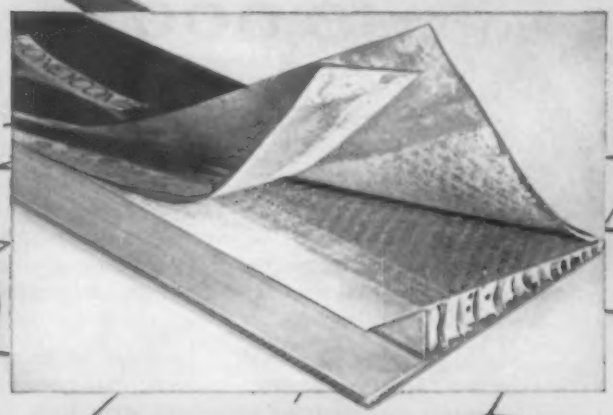

Section through a trailing edge, showing honeycomb sandwich wing construction. Laminations such as these may be assembled immediately after application of solvent-free Epon resin adhesives.

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erators. An obstacle course for training is also depicted. Write for Form 1214 to Hyster Co., Portland 8, Ore. . . . **Electronic template and cam machine** Model 104 for milling and grinding internal and external contours is described in folder available from Pratt & Whitney Division, Niles-Bement-Pond Co., W. Hartford 1, Conn. . . . **Engineering principles of spring lock washers,** containing numerous charts and drawings, is available from Spring Washer Institute, 74 Trinity Place, New York 6, N. Y.

Sound reduction doors for jet engine and reciprocating engine test cells are described in 8-page bulletin put out by Jamison Cold Storage Door Co., Hagerstown, Md. . . . New 20- page catalog describes **precision torque-limiting wrenches** and accessories. Write Jo-Line Tools, Inc., 8442 Otis St., South Gate, Calif. . . . Cro-Plate Co., Inc., Hartford, Conn., is offering two technical bulletins on **pressure blast wet-blasting equipment:** "Cleaning Prior to Electro-Plating With Pressure Blast," and "Deburring With Pressure Blast." . . . File of technical literature on **Iridite chromate conversion coatings** for prevention of corrosion and paint-base treatment of non-ferrous metals is available from Allied Research Products, Inc., 4004 E. Monument St., Baltimore 5.

New Publications

Airline traffic publications, covering passenger and cargo rules, fares and rates tariffs particularly international, will be offered by Barrington's Traffic Service, to "fill the vacuum created when the consolidated tariff was dropped" by International Air Transport Assn. in October. The service will also offer analysis and surveys of traffic problems and route potentials and act in similar consulting fields. William D. Barrington previously published the consolidated tariffs for IATA, has been with the Air Traffic Conference of America, Colonial Airlines and Civil Aeronautics Board. Write to Barrington Traffic Service, 51 E. 42 St., New York.

To encourage aviation activity in American schools, a series of five bulletins reporting how the University of Illinois Institute of Aviation operates, is being published. Initial title: Aviation Ground School; coming up are: Organizing for Flight Operations, Developing an Aircraft Maintenance Curriculum, Airport Shop Operations, and College and University Airport Management. The series is financed by Link Aviation Foundation. University of Illinois is at Urbana-Champaign.

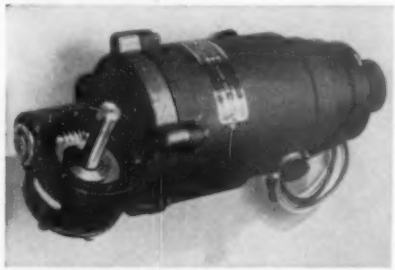
DOW CORNING CORPORATION

Silicone News

FOR DESIGN ENGINEERS

Silicone Grease Saves Money; Increases Life of Alloy-to-Plastic Gears in Precision Gearmotor

Using the best organic lubricants, maximum life of the gear set in a test model of a new precision gearmotor designed by Lee Engineering Company of Milwaukee, was only 100 hours. Temperature at point of contact between the nickel alloy worm and phenolic gears was so high that organic lubricants were rapidly separated and thrown out, even though the gearbox was fully packed.

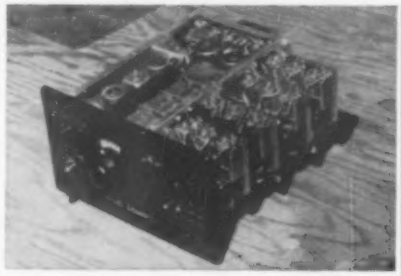


Before major alterations in design were undertaken, Lee engineers tried Dow Corning 33 Grease, light consistency. A first trial run of 1200 hours showed no appreciable gear wear. Further tests proved that a basically sound design had been made practical by a stable lubricant.

With only enough Dow Corning 33 to fill the teeth required to give long service, Lee engineers found that even the initial cost of the silicone grease was less than that of a gear box-full of the organic grease previously tried.

Now in commercial production, these silicone lubricated precision gearmotors are put to many uses. For example, the ⅛ hp unit shown here with a 40 to 1 gear ratio and a speed range of 10 to 200 rpm on the phenolic gear, is used to feed wire in an automatic welding machine. *No. 24*

New 1955 Reference Guide to Dow Corning silicone products gives in 8 pages a brief but comprehensive summary of the properties and applications for the silicone products that are most widely used. Products are indexed by type of application. With increasing effort devoted to product improvement and cost reduction, such a reference guide to this remarkably stable group of engineering materials becomes increasingly important to design engineers. *No. 25*



RF Transformers Impregnated with Silicone Fluid Exceed Humidity Specs

The RF transformers in radio compasses made by LearCal Division of Lear, Incorporated, passed Ordnance tests for moisture resistance and extreme thermal shock. Lear felt, however, that for permanent protection, the transformers should be potted to come as close to forming a true hermetic seal as possible.

After potting with mica-filled epoxy resins, the transformers are, therefore, vacuum impregnated with Dow Corning 200 Fluid. Silicone treated transformers easily pass the humidity tests of SC-D-1594 and MIL-E-5400. They may be immersed in water for 30 minutes with no change in electrical properties. *No. 26*

Westinghouse Seals New Switches With Silastic for Sub-zero Service

Sealed, top and bottom, with Silastic gaskets, the new Westinghouse gas-filled, load interrupter switches remain operable at temperatures as low as —65 F. Organic rubber seals were originally tried, but sub-zero weather caused the seals to harden and shrink, allowing the sulfur hexafluoride gas to escape.

On testing, Westinghouse engineers found that Silastic gaskets easily passed all pressure, vacuum, and temperature requirements, and were not affected by the gas. The Silastic gaskets provide such a tight seal that Westinghouse expects the units to hold gas pressures of 30 psi indefinitely without recharging. *No. 27*

Silicone Aluminum Paint Protects Jet Engine Combustion Chambers

The materials used in many of the combustion chambers and burner supports manufactured for J-35 jet engines by Solar Aircraft of Des Moines, must remain unaffected by abnormally high temperatures. Aluminum clad steel solves the problem satisfactorily with exception of various fusion welds. These must be recoated with aluminum or a noncorrosive coating that will withstand up to 800 F.

Solar engineers have the answer to that problem, too. They simply spray or dip the welded part with two coats of Sicon, an aluminum paint formulated with Dow Corning silicone resins by Midland Industrial Finishes.

After a one hour bake at 400 F, the silicone based coating provides the required protection. According to Solar, this is one of the most satisfactory paints for use on jet engine parts. *No. 28*

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LETTERS

Whose Avionics?

(Editor's note: Aviation Week's recent series of articles by Avionics Editor Philip Klass dealing with the airframe industry's inroads into the avionics field and the factors which may restrain further movement, has brought a wide response and request for reprints. Here are a few of the comments received.)

The staff of the Senate Small Business Committee has followed with great interest your series of articles on the avionics industry. We feel that you and Aviation Week have done a fine job in bringing this information together in one place.

As you know, we have been following closely some of the problems which were pointed out in the series, and I hope we will be able to work together on them.

It would be greatly appreciated if you would forward to this Committee 10 reprints of the series of articles which were described and to which you referred in the inset on page 56, Aviation Week, Jan. 3, 1955.

Thank you for your consideration of this request at your earliest convenience.

Walter B. Stults
Staff Director
United States Senate
Select Committee on Small Business
Washington, D. C.

I have read with interest the articles on avionics which have appeared recently in your magazine. I note your effort to furnish single copy reprints of these articles on request, and I would appreciate your sending me a copy of each, addressed to me at the following address:

Rudolph F. Gagg
Office, Assistant Secretary of the Air Force (Materiel)
Room 4 D 873—The Pentagon
Washington 25, D. C.

Appreciate four copies your recent series on avionics engineers in the aircraft industry. Certainly your article covers a most interesting subject in all its facets.

C. E. Tremblay
Manager Aviation Dept.
Canadian Marconi Co.,
970 McEachran Ave.,
Montreal, Canada

The Jan. 3 issue of Aviation Week has arrived and I have just finished reading your concluding article on the avionics industry.

I believe the series was excellently done and realistically reflected the current situation in this new industry. It will be interesting to see, as time goes on, how the avionic and aircraft industries organize themselves.

We have many copies of Aviation Week in the plant. However, I would like to be certain that this series is read by all of our people who will have a hand in directing our activities. I would appreciate your having your distribution people send me 100 reprints of this series; direct the invoice to my attention.

Raymond R. Neevel
Assistant to the General Manager
Hughes Aircraft Co.
Culver City, Calif.

Please forward a copy reprint of your recent article on the avionics industry.

G. H. Orgelman
Supervisor, Engineering Personnel
Chance Vought Aircraft, Inc.
Dallas, Tex.

Kindly send me a reprint of the series of articles on the avionics-airframe industry as mentioned in the Jan. 3, 1955, issue of Aviation Week.

A. P. Gertz
Department Head
Weapon System Engineering Dept.
Sperry Gyroscope Co.
Great Neck, L. I., N. Y.

It is requested that a copy reprint on your past avionics series be forwarded to the undersigned.

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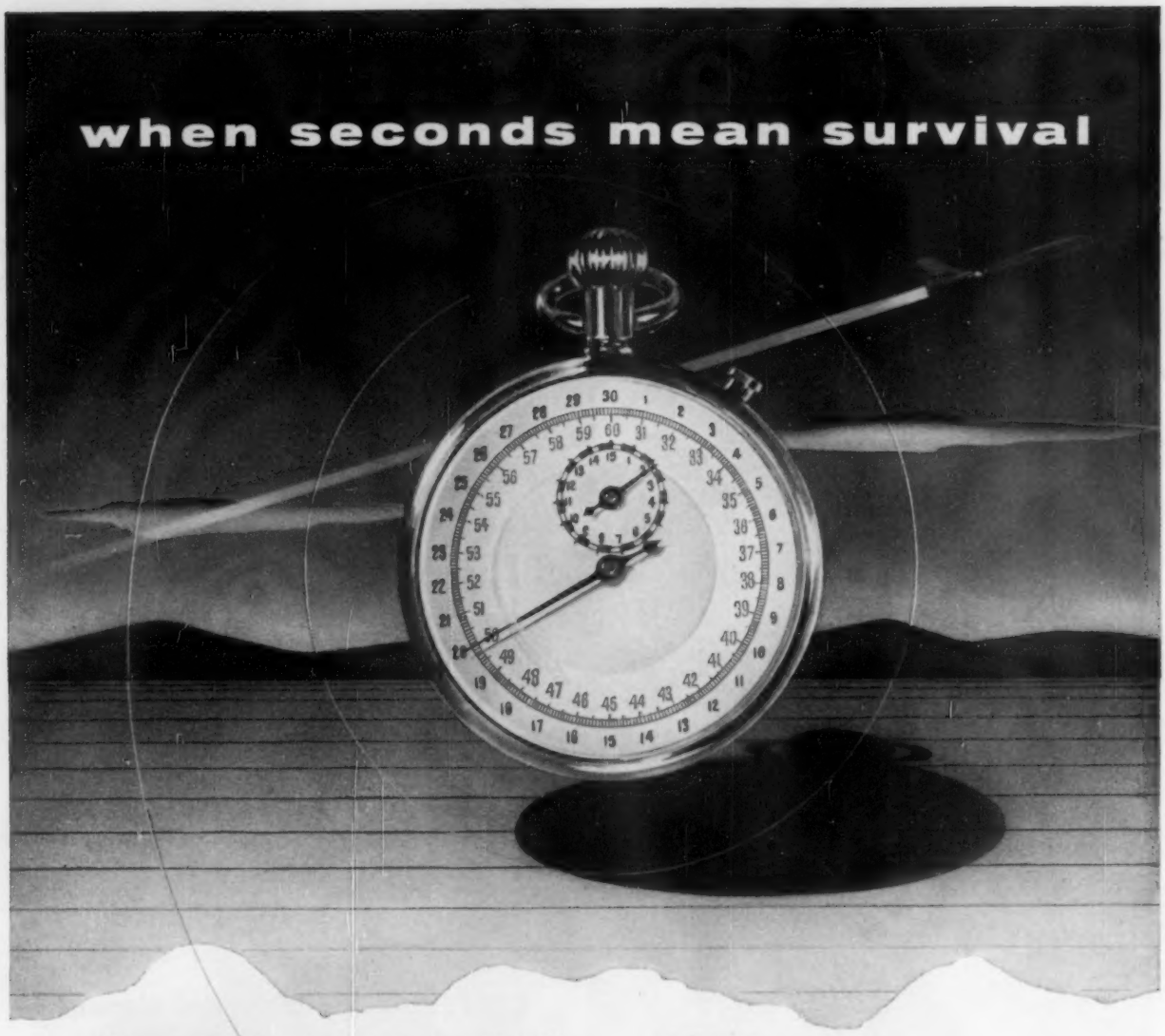

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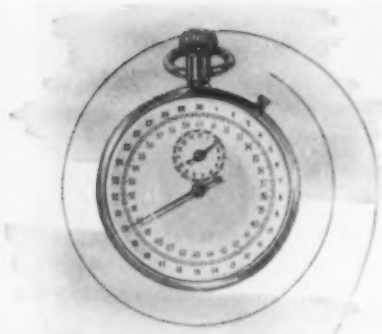

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Just now Dr. Jack Bolljahn asked if he could also receive one. These are the most interesting and informative of anything I have read in a long time. Congratulations on your very fine work.

A. S. Brown
Special Assistant to Director
of Engineering Research
Stanford Research Institute
Stanford, Calif.

Please send us one copy each of your series of articles on avionics-airframe industry dilemma.

Robert C. Main
Operations Manager
GLM #3011
The Glenn L. Martin Co.
Baltimore 3, Md.

VFR Traffic Law

In regard to the letter "VFR Traffic Law" in issue of Jan. 17, 1955:

It seems that "executive pilot," in his letter printed in the Jan. 17 issue, is not familiar with the rules he would like to have changed. VFR is not a law but a condition, and as such, cannot be abolished. Probably he is referring to the prerogative that a traffic controller has of authorizing flight clear of clouds in a control zone when weather is below VFR minimums. In such case, IFR traffic has full priority, and I'm sure no controller would authorize flight clear of clouds when IFR traffic exists.

And when "executive pilot" makes any approved instrument approach, it will be in a control zone, in which he will find there is already traffic control down to the ground. The 700-ft. airway boundary he refers to pertains to control areas, in which he would be illegal that low on IFR.

It is true that "Dilbert" can legally be cruising along in the middle of the localizer. But to be legal, he must have three miles visibility and be at least 500 ft. below the cloud ceiling. This allows "executive pilot," on his approach, a full minute or more after breaking contact to look around and avoid proximity to VFR traffic. This should be adequate regardless of what aircraft he's flying.

But yes, "Dilbert" may not always be flying legally. Either intentionally or in ignorance, he may be in the control zone at about cloud level, and without informing the controller of his presence. Such lawlessness, however, would not be reduced by raising the VFR weather minimums. In fact, the opposite would probably result.

I heartily agree with the suggestions offered regarding more effective law enforcement. Steps in this direction should be taken. However, enforcement will always be difficult. Probably most of the answer lies in "executive pilot's" suggestion No. 6 regarding an educational campaign. I'm sure that if notice were posted that 8:00 P.M., on the second Wednesday of next month, at the local high school, the C. A. A. would conduct an informal discussion on the practical application of CAR 60, they would be surprised to find an audience of a hundred or more pilots, eager to recall some bit of the regulations which have long since been forgotten.

No, the present rules are not "antiquated." All that is needed to make them work is to abide by them.

Paul W. Tracy
Family Pilot
Thomas St.
Brentwood, N. Y.

Airline Profits

The Jan. 3 issue of Aviation Week, page 77, presents the ATA "United States Flag Airlines Box Score for '54" under the caption, "Everything Higher in '54 but the Profits."

If one assumes that profits (or losses) represent the difference between total revenues and total expenses, then I would be inclined to challenge the accuracy of your caption as well as the general tenor of the related article. I note that estimated aggregate net profits for 1954 increased roughly from $19,400,000 to $29,800,000, and, according to my calculations, this increase of $10,400,000 represents an improvement of some 54%, which percentage is greater than that of any other box score item. It would appear, therefore, that a more accurate caption would be, "Everything Higher in '54 and Particularly Net Profits"!

Don't misunderstand me. I am not implying that the profits as indicated are excessive. It may be that they are not even adequate.

W. W. Niles
5616 Nevada Ave., N. W.
Washington 15, D. C.

Lost Plane Signals

In view of the current interest in radio search equipment which could be used in the location of lost aircraft and personnel, I think your readers may be interested in knowing the progress that has been made in the adoption of SARAH (search and rescue and homing equipment). This is the miniature radio-radar equipment which is small enough to be carried by most personnel (sending equipment weighs approximately 3 lb.). It is designed and is currently manufactured by Ultra Electric, Ltd. of England, with Simmonds Aerocessories handling the sales and manufacturing rights is the U. S. An excellent description of this equipment was carried in your issue of July 6, 1953.

Since that time, SARAH has been adopted as official equipment by the Royal Air Force. Evaluation tests are also being conducted by our own military services and other U.S. government agencies, but these are of a classified nature. Several of the U.S. airframe manufacturers have ordered SARAH equipment and plan to use it in their own flight test programs for the location of downed personnel.

We are very much in agreement with your correspondent (Aviation Week Dec. 20, 1954, p. 90) that everything possible should be done to expedite the universal acceptance and use of this type of safety equipment and welcome any publicity which you feel would help accomplish that goal.

Neil D. Naiden
Assistant to the President
Simonds Aerocessories, Inc.
Tarrytown, N. Y.

PRODUCTION

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Whether you're an engineer who wants technical information in a hurry, or a new user of tubing looking for the full story of stainless and high-alloys, you'll find this booklet equally valuable.

In it, discussed by classification, you'll find data on pressure, sanitary, mechanical, heat-resistant, ornamental and other forms of stainless and high-alloy welded tubing. There are engineering data on joining methods, welding techniques, bending and installation hints. Also included are complete tables of bursting pressures, physical and chemical properties of stainless steels and other alloys, and corrosion and temperature data. This is only a partial list of contents, but it will give you an idea of the wealth of pertinent, factual information the booklet contains.

To get your free copy, just drop us a note on your company letterhead. There is no obligation, of course.

TRENTWELD

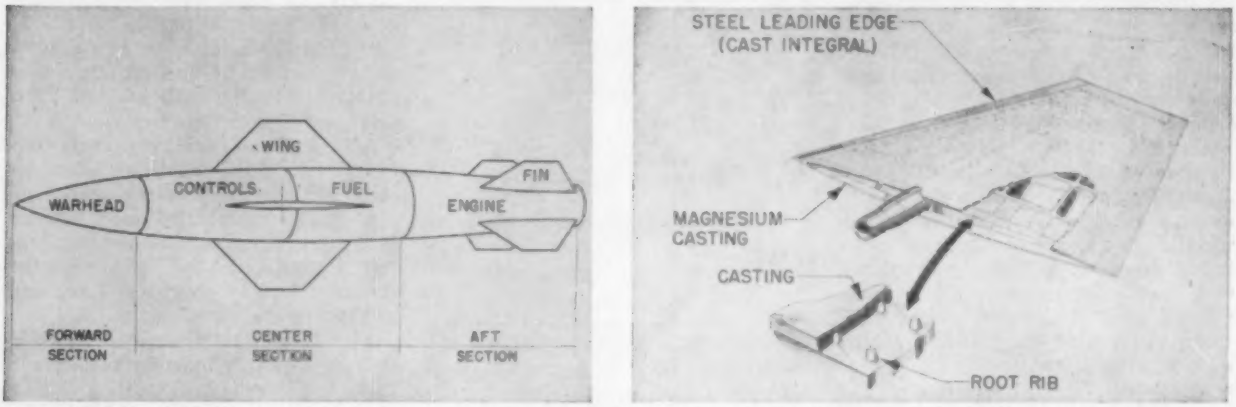
STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

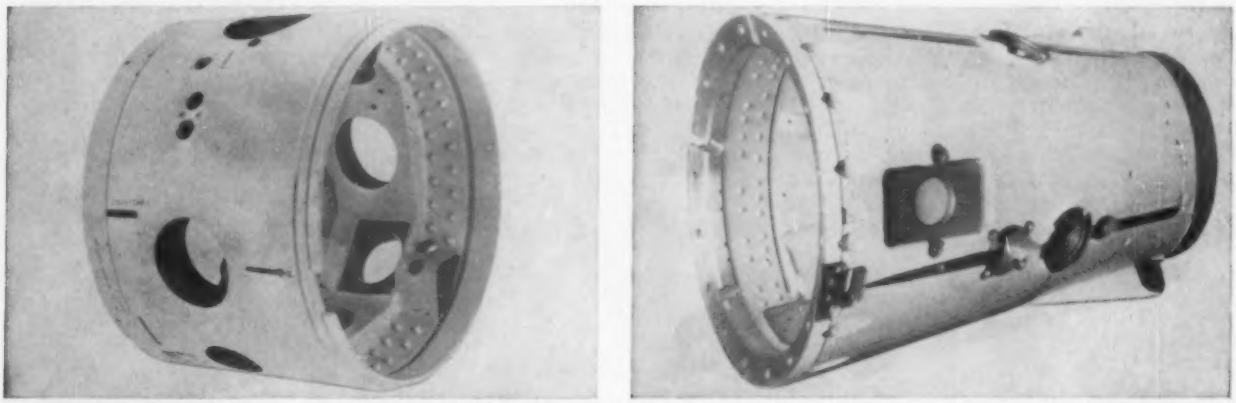
metal temperature in the pouring of the casting.

EFFECT OF ELEVATED TEMPERATURE

core cast integrally by means of a bi-metallic bonding process has been suc-



IN TYPICAL MISSILE configuration (left), wings, wing support, aft section, fins and internal parts lend themselves to casting construction. Sketch at right shows how cast magnesium wing fits over pegs on steel box root rib for integral assembly.



AS-CAST WING SUPPORT structure (left) has holes for control shafts. Aluminum rings are riveted to each end and threaded inserts provide for attachment of adjacent sections. Aft section casting (right) is thin shell with stiffeners and frames.

Important Benefits Seen As . . .

Magnesium Castings Aid Missile Design

Magnesium castings are playing an important role in the development of today's and tomorrow's guided missile. Large castings are being used for many jobs in the missile structure. Here are some of the benefits:

• **Relatively quick manufacture** is provided by cast makeup in comparison with built-up structure. This spells economy, a big factor in the missile, because it is a one-shot weapon.

• **Magnesium has inherent stiffness-to-weight** characteristic for meeting aeroelastic and structural stability problems.

Other important benefits are seen for the material in new alloys reported to fit temperatures up to 700F—well within missile flight temperature ranges.

► **As Primary Structure**—Specific applications of magnesium alloy sand castings in missile construction were revealed by A. J. Bell, engineering group supervisor at John Hopkins University's Applied Physics Laboratory, at the Tenth Annual Meeting of the Magnesium Assn., in St. Louis.

In the typical guided missile Bell considers—a supersonic type with a relatively short flight time, perhaps up to 5 min.—large one-piece magnesium castings are being successfully developed to replace complex, built-up members. These castings may consist of thin-walled outer shells serving as aerodynamic surfaces while including primary internal-structure equipment-mounting pads and shoulders.

Generally, magnesium castings in these applications have brought significant savings in cost with no increase in weight.

► **Wing Castings**—Wings and wing support structure are ideally suited for casting applications, Bell says. A magnesium wing casting, cored to form skin, ribs and spars, is cast integrally with a steel box root rib. Critical aerodynamic dimensions—span, chord and thickness—are cast to within ±.030 in. and with surface finishes from 125 to 250 microinches rms.

Shear loads between the root rib and the surrounding casting are taken by pegs and dimples in the rib. Close fit is obtained by shrinking the cast magnesium material onto the pegs.

A bimetallic bonding process is under consideration, Bell reveals, in which the steel root rib is cast in place. No pegs would be required and the shear loads between rib and casting would be carried by the molecular bond between the magnesium and steel. But here, he says, the strength of the highly stressed heat-treated steel root rib may be affected adversely by the high molten

Capital Airlines

metal temperature in the pouring of the casting.

▶**Wing Support**—A wing support casting incorporates holes for the wing control shafts and considerable detail such as bosses and section variations. Riveted to each end of the casting are aluminum rings, and thread inserts provide for attachment of adjacent missile-sections.

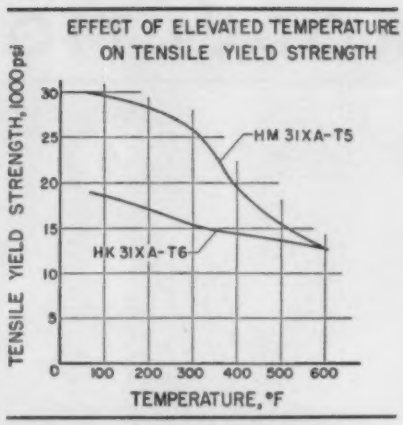
The wing support—primary aircraft structure—must take the high wing loads induced by missile maneuvers. With movable wings, it must also take high wing hinge movements at the control linkage supports. In this complex structure, cast construction inherently provides a rigid structure free from the many mechanical joints in a built-up unit, Bell says.

▶**Aft Section**—In this portion of the missile, also primary airframe structure, it is desirable to use cast construction wherever practicable from a weight and cost standpoint.

The magnesium aft section casting Bell describes consists of a thin-walled outer shell with internal stiffeners, frames, and holes for fin attach studs.

At the forward edge, an aluminum ring is attached to provide a suitable connection for the adjacent section.

Strength requirements, Bell points out, are based primarily on the high bending moments induced during handling and launching and fin load reactions during flight.



TENSILE YIELD-TEMPERATURE relationship for Dow's HK31XA (casting and sheet) and HM31XA (extrusion) alloy.

▶**Fin Units**—A magnesium fin casting has ribs and spars integrated in the configuration. Other features are riveted magnesium skin and steel pins.

Short flight times usually associated with the boost phase make magnesium particularly attractive for booster components. A magnesium booster fin with steel shaft and rectangular cross-section core cast integrally by means of a bimetallic bonding process has been successfully developed, Bell says.

Here, the shear loads between shaft and casting are carried satisfactorily by the molecular bond between the magnesium and steel. This process also is adaptable to the missile wing and fins previously described, he claims.

▶**Avionic Box**—There are many secondary structural applications where magnesium particularly fits.

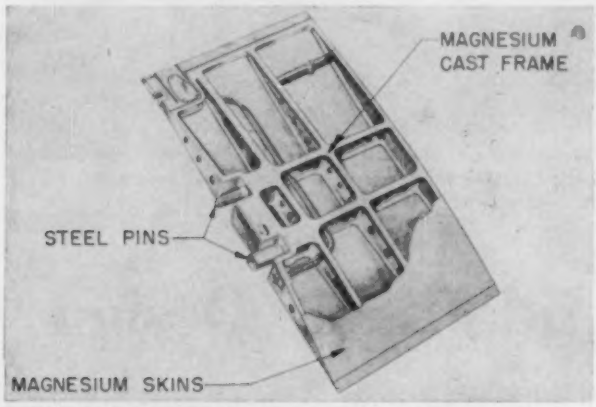
One is a cast, thin-walled box for housing missile avionic equipment. This can be produced for a fraction of the cost of a built-up sheet metal box and at about the same weight.

Most important feature of the box, Bell claims, is its inherent rigidity and corresponding high resonant frequencies.

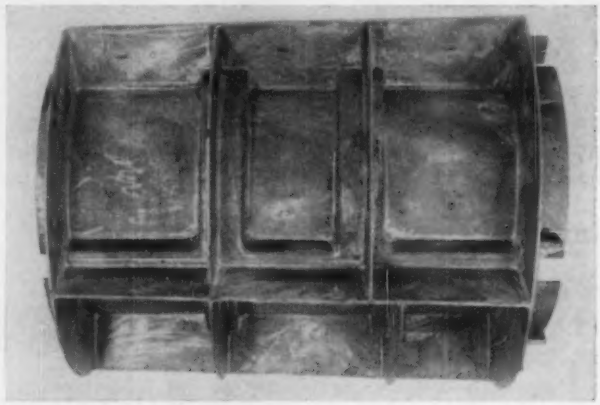
▶**Supports**—Other secondary structural applications include heavy electrical and hydraulic equipment support structure.

Thus, a magnesium T-section casting for supporting hydraulic components has drilled holes for manifolding the principal units. Leakage at the component mounting pads is avoided, Bell says, by impregnating the assembly with a plastic sealing compound.

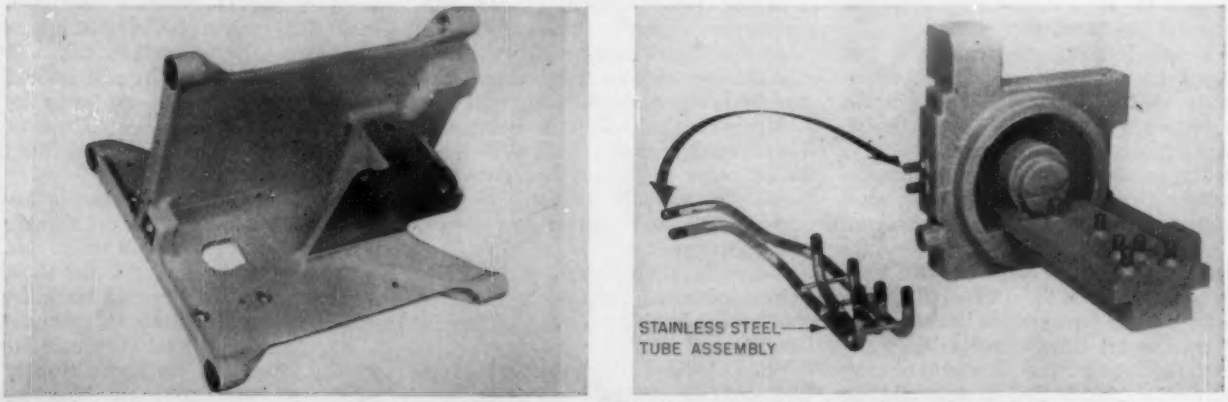
▶**Bonded-In Lines**—Other key applications for magnesium castings include air,



MAGNESIUM CAST FIN is spar and rib configuration, covered by riveted magnesium skin.



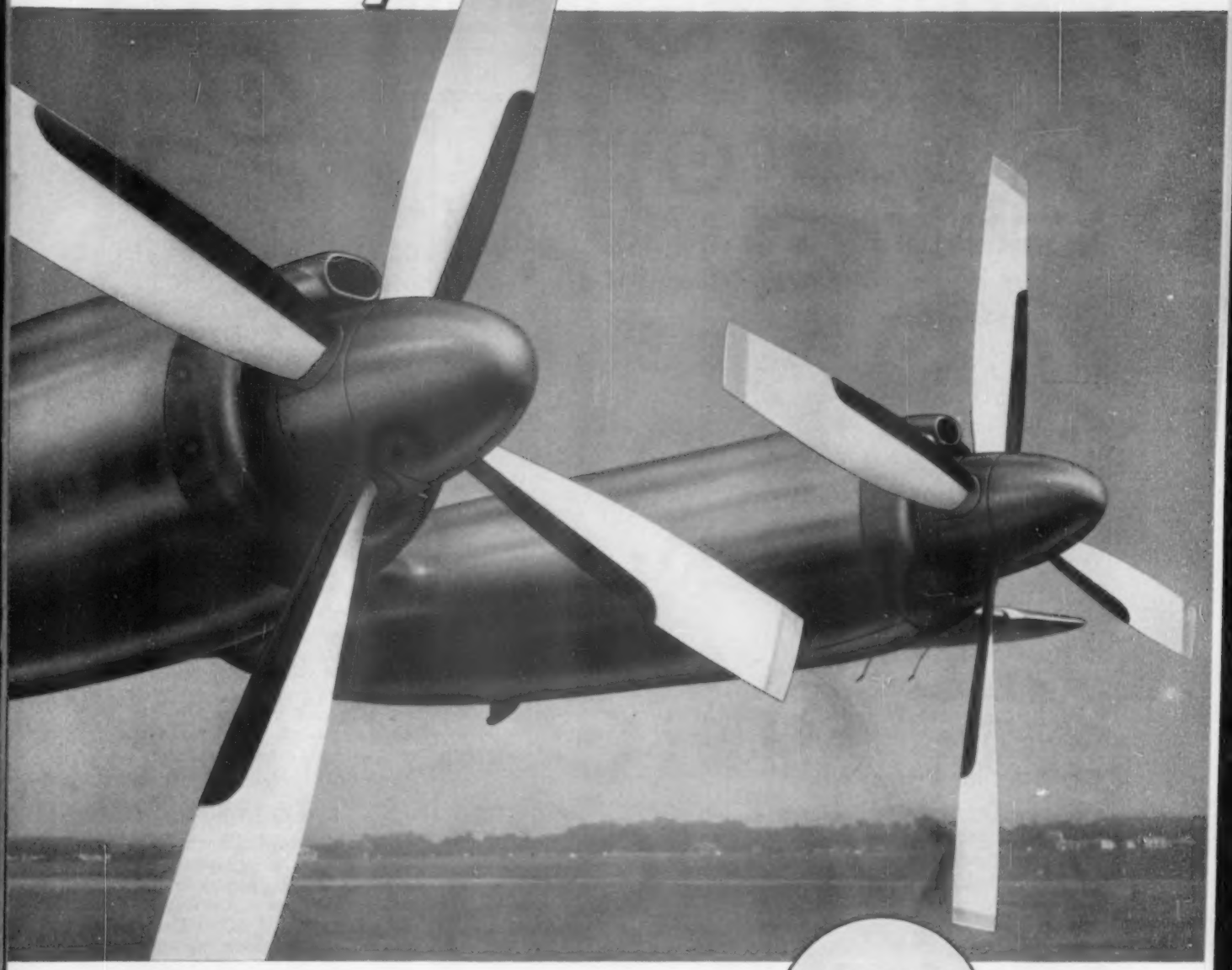
MAGNESIUM CAST BOX possesses rigidity. It accommodates the missile's avionic equipment.



HYDRAULIC SUPPORT casting is T-section, has drilled holes for manifolding. Manifold housing (r.) has integral tube assembly.

MATERIALS HANDLING NEWS

Capital Airlines



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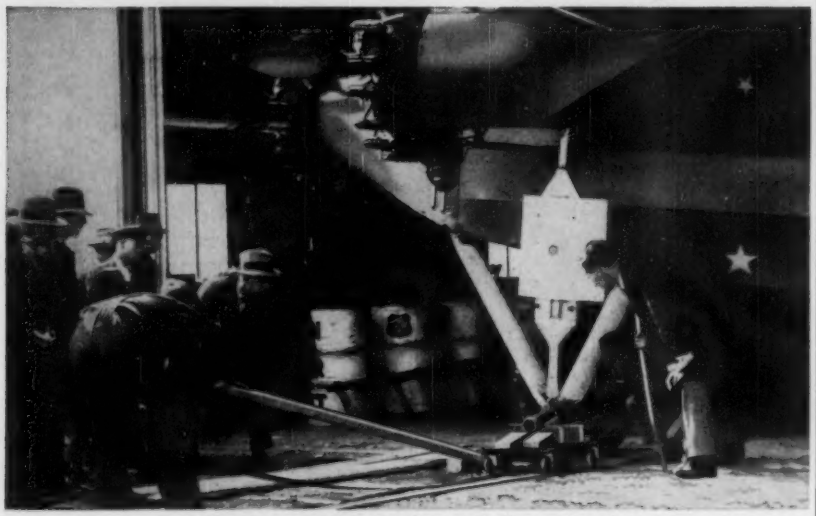
MATERIALS-HANDLING NEWS

★ Panel Discussions by Bassick, World's Largest Manufacturer of Casters and Floor Protection Equipment ★

From "Southern Cross" to B-36-- Bassick takes over on the ground

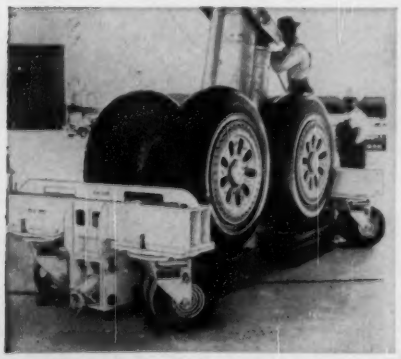


"Southern Cross," standing on dollies equipped with Bassick casters, gets once-over from Australian pilot Kingsford-Smith (right).

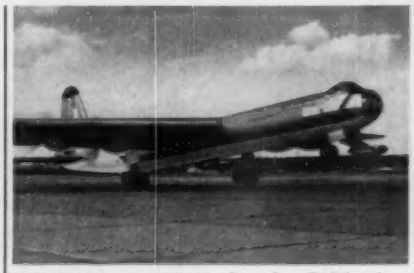
Flying the big ocean

In early June, 1928, the 3-engine "Southern Cross", piloted by Kingsford-Smith, made the world's first trans-Pacific flight from San Francisco to Brisbane, Australia.

Proven conventional Bassick casters were selected for pre-flight handling of the "Southern Cross". Today Bassick casters are specifically designed to meet exacting requirements for safe efficient handling of modern aircraft.



80,000 lbs. is no strain for these 4 Bassick casters.

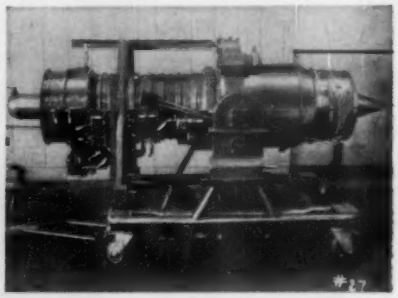


Another Convair-built 6-engine B-36 takes off.

25 years later

Convair of Fort Worth, Texas, chose Bassick to produce the highly specialized dual 18″ wheel "Floating-Hub" shock-absorbing caster for their B-36 handling dollies. These 675-pound giants have an operational load rating of 20,000 pounds each yet permit easy, precise handling of these huge Air Force bombers in production. Bassick's "Floating-Hub" shock absorbing casters help preclude airframe damage during assembly by eliminating winding stress, shock and vibration due to dolly handling — write for "Floating-Hub" catalog FH-53.

Fretting corrosion?



"Fretting corrosion", killer of modern jet engines, is another problem licked by Bassick's patented "Floating-Hub" casters — the only caster designed to absorb both horizontal and vertical shocks.

When wheels equipped with "Floating-Hub" roll over obstacles or rough surfaces, their deflection is controlled and their recovery immediate — preventing damaging shock forces, vibration and winding stress from being transmitted to the vehicle or precious cargo. Vibration frequencies are interrupted and immediately damped out by the inherent snubbing action, precluding resonance and "fretting corrosion". Ask for catalog FH-53.

New caster feature

Grease dripping from bearings exposes them to premature wear — increasing maintenance and repair cost. It's also an accident hazard and harms floor surfaces and rubber tires. Cure: Bassick grease retainer cup now *standard* on all Bassick Series 99 casters.

Get all the facts on the most complete line of shock-absorbing and conventional casters from your Bassick industrial distributor. He's got the stock and the know-how to give you fast efficient service on all your requirements.

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fuel and hydraulic manifold housings with bonded-in steel lines. The housing and tube assembly are made integral by means of bimetallic bonding, giving a lightweight, low-cost manifold suitable for 3,500-psi. hydraulic service.

This construction eliminates the majority of machining operations, minimizes scrap due to improper passage-drilling, and results in lower system line losses, Bell says.

▶ **Material Data**—Casting materials used in these applications are, in the main, Dow Chemical Co.'s AZ63A, AZ91A, and AZ92A alloys in the as-cast and heat-treated and aged conditions. Each casting is given a chrome-pickle treatment (Dow No. 1) at the foundry, and after machining is given a dichromate finish (Dow No. 2) according to military specs.

Where the casting is joined to dissimilar metal, it is impregnated with a sealing compound to protect against galvanic corrosion.

Also, those assemblies which are potential fire hazards are coated with fire-retardants (Dow No. 17 or HAE) and a superimposed paint finish.

Magnesium die castings, extrusions and forgings should be equally well suited, but current production quantities in most instances do not warrant their application, Bell says.

▶ **New Alloys**—Present and future missile performance improvements will extend flight temperatures well into the 500-1,000F range, thus indicating a need for continuing development in high-temperature magnesium alloys if a future role for the metal is to be assured.

The new high-temperature alloys containing rare earths or thorium, being developed by Dow and by Magnesium Elektron Ltd., offer promise of continued and extended use of magnesium in missile construction.

Representative of these newer alloys are Dow's HK31XA (casting and sheet) and Dow's HM31XA (extrusion). The designer now has available new magnesium alloys competitive with, and in some cases superior to, other light alloys for use over certain temperature ranges up to 700F, Bell points out.

▶ **Production Difficulties**—There continues to be a need, he says, for increased high-quality magnesium sand-casting production and improved controls at the foundry. Castings suitable for missile construction require this close production control to insure required dimensional and structural qualities.

There is still a high casting-rejection rate, Bell reveals, because of poor dimensional controls, distortion, cracks and other flaws which may be corrected by improved coring and metal flow, and cooling techniques.

▶ **Improvements Needed**—A few outstanding foundries in the country are

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The Herman Nelson Portable Air Heater is a reliable "cold weather friend" at all U. S. Air Force bases
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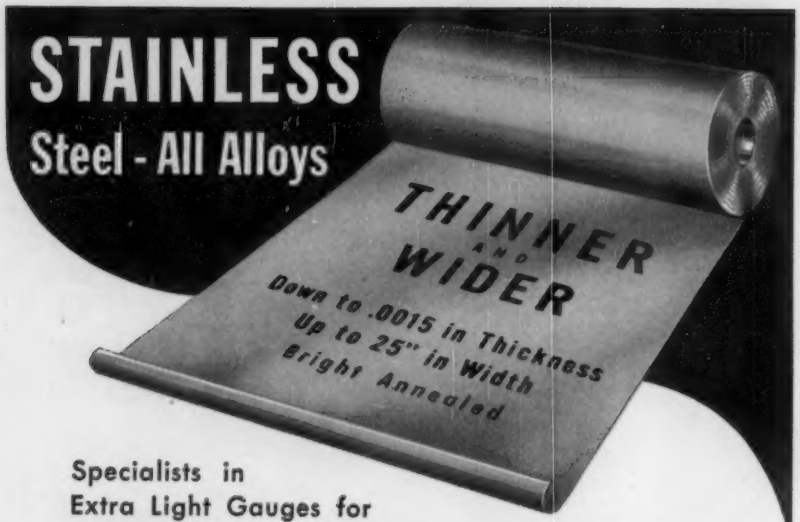

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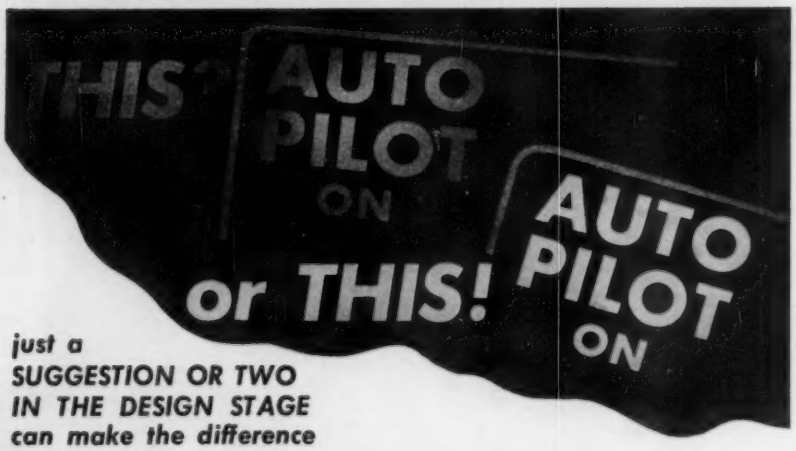

just a
SUGGESTION OR TWO
IN THE DESIGN STAGE
can make the difference

Production difficulties can usually be resolved in the design stage. Flexibility in the location of a light hole, the possibility of a slight relocation of a letter, word or legend, the introduction of a special light diffuser, or carrier, can make the difference between a uniform, well lighted unit or a unit which just falls within specification limits.

Our plants are completely equipped and staffed by experienced engineers trained to produce to the exacting requirements of specification MIL-P-7788, or any special requirement your particular application may demand.

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doing an excellent production job in large thin-walled precision sand castings but, Bell says, because of their limited production capacity, delivery lead times are too long and often a controlling factor in production scheduling.

Medium and large precision sand-casting techniques should be improved to where quality and accuracy approach that found in die castings, he says. This means wall thicknesses of ⅛ in. or less, uniform structural strength, accuracy of a few thousands on critical dimensions, and critical surface finishes of 100 micro-inches or better.—**Irving Stone**

Aviation Firms Get New Tax Writeoffs

Office of Defense Mobilization has issued Westinghouse Electric Corp., Churchill Borough, Pa., a $7,730,000 certificate of necessity for rapid tax amortization for a research and development facility with 25% allowed.

Other certificates include:

Kearfott Co., Inc., Little Falls, N. J., precision scientific instruments for aircraft, $45,167 certified with 65% allowed; Van Nuys, Calif., precision aircraft instruments, $27,298 certified with 65% allowed.

Collins Radio Co., Cedar Rapids, Iowa, electronic equipment, $94,903 certified with 65% allowed.

Liquidometer Corp., Bellows Falls, Vt., scientific instruments for defense, $35,000 certified with 55% allowed.

Boeing Airplane Co., Seattle, military aircraft, $267,074 certified with 60% allowed.

Liberty Products Corp., Farmingdale, N. Y., aircraft parts, $98,502 certified with 65% allowed.

Cramet, Inc., Chattanooga, Tenn., titanium metal ingots, $4,969,400 certified with 90% allowed.

Control Instrument Co., Inc., Brooklyn, N. Y., military electronic equipment, $64,210 certified with 65% allowed.

USAF Contracts

Following is a list of recent USAF contracts announced by Wilkins Air Force Depot, Shelby, Ohio:

Bunke-Musser, Inc., P. O. Box 386, Jackson Center, Ohio, trailer, engine and shelter heater, 2 wheel, type MA-1, 2,126 ea., $286,715.

Hoye Textile Corp., 112 Franklin St., New York, N. Y., cloth, mercerized cotton, airplane, 42 in. wide, 43,250 yd., $27,096.

Waco Aircraft Co., Troy, Ohio, kit, front axle modification, type MA-1 IAW, 1,341 ea., $227,312.

Fred C. Good & Sons, Inc., 521 W. Glenwood Ave., Philadelphia 40, kits, airplane mooring, 1,563 ea., $88,231.

The following contracts were recently announced by Topeka Air Force Depot:

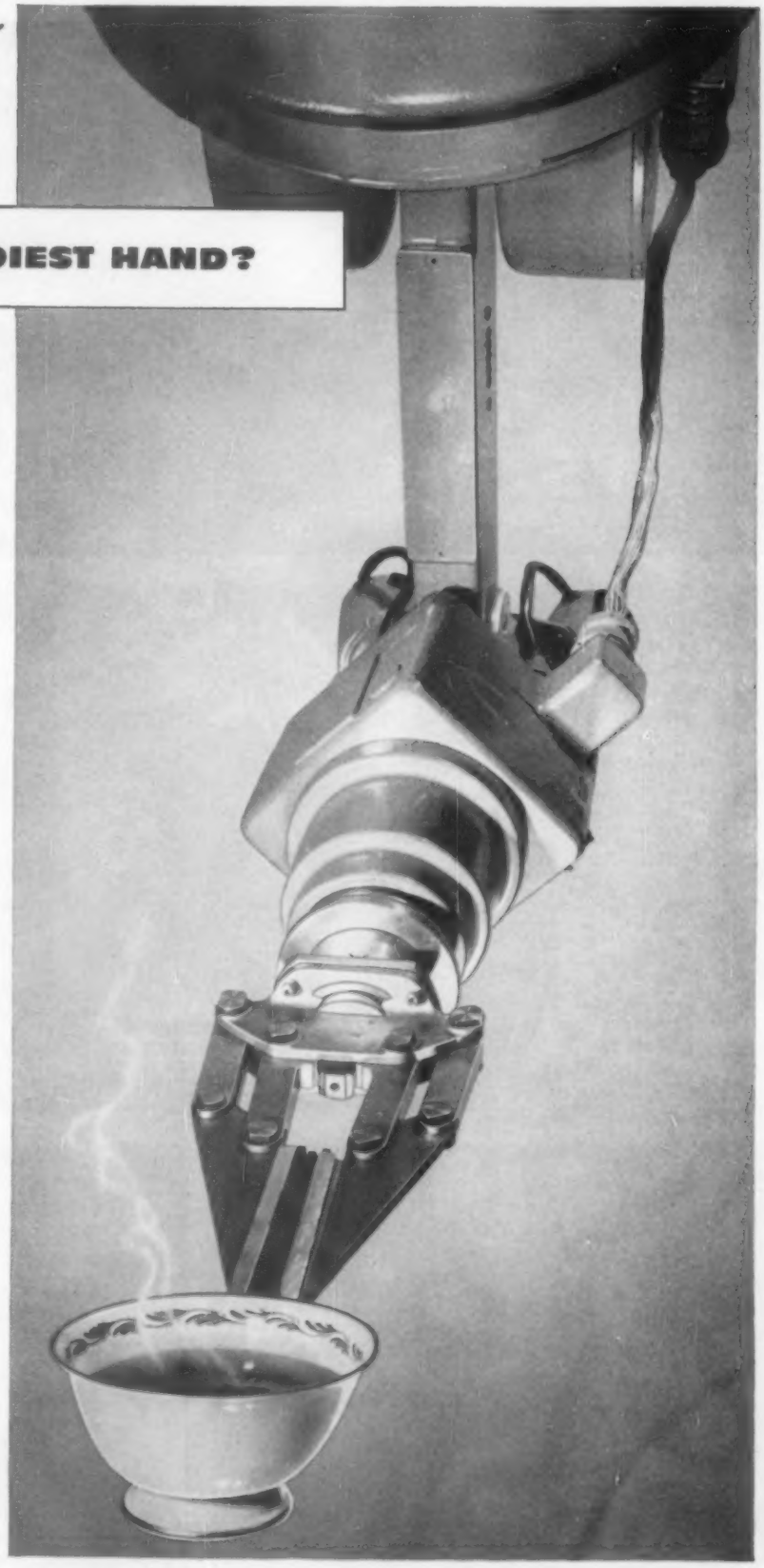
Aeroquip Corp., 300 South East Ave., Jackson, Mich., fittings, end, 73,463 ea., $56,452.

Camloc Fastener Corp., 22 Spring Valley Road, Paramus, N. J., stud assys., 150,000 ea., $29,301.

Eagle Lock Co., Terryville, Conn., screws, wood, 5,365,300 ea., $25,572.

Flex-O-Tube Div., Meridan Corp., 2525 Jim Daly Rd., Inkster, Mich., fittings, end, 215,938 ea., $50,961.

Metimpex Corp., 666 Fifth Ave., New



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The unit offers superb control (it can handle a teacup with a dowager's finesse) and unusual strength (lifts 750-pound objects with its one hand). Fully coordinated controls are easily mastered and eliminate many of the restrictions found in hand-powered or position-controlled mechanisms.

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WE'VE JUST PASSED THE FRANKLIN MARKER, JACK. WHAT'S THE LATEST PORTLAND WEATHER?
WEATHER'S STILL BAD—LATEST REPORT SAYS THEY HAVE 300 AND ½ MILE VISIBILITY.
HAVE YOU IN RADAR CONTACT. THIS WILL BE A PRECISION APPROACH TO RUNWAY 4. TURN LEFT HEADING 090. DESCEND TO AND MAINTAIN 2000—NOW CONTINUE TURN TO 045.
ROGER. LEAVING 3000.
PORTABLE GCA RADAR SPAR UNIT
YOU'RE OVER THE OUTER MARKER AT 2000. START A NORMAL RATE OF DESCENT.
ROGER.
EVERY TIME WE MAKE A GCA LANDING, I'M IMPRESSED BY SPAR'S ACCURACY.
I KNOW WHAT YOU MEAN, JACK—BECAUSE IT'S SO SMALL AND PORTABLE.
PRETTY SOON THERE'LL BE A SPAR AT EVERY FIELD.
NO REASON THERE SHOULDN'T BE—SPAR COSTS SO LITTLE NO AIRPORT CAN AFFORD TO BE WITHOUT IT...
FLIGHT OPE ATIONS

HELLO—PORTLAND TOWER. THIS IS NORTHERN FLIGHT 340—OVER FRANKLIN MARKER AT 3000—REQUEST A GCA APPROACH TO PORTLAND
ROGER. NORTHERN 340—CONTACT PORTLAND RADAR ON 114.7 MEGACYCLES.
NORTHERN 340—THIS IS PORTLAND RADAR. WE HAVE YOUR POSITION REPORT. TURN RIGHT HEADING 120 FOR IDENTIFICATION.
NORTHERN 340—ROGER.
TURN LEFT HEADING 040. YOU ARE NOW 100 FEET HIGH ON GLIDE PATH. INCREASE RATE OF DESCENT.
COURSE O.K. YOU ARE NOW BACK ON GLIDE PATH—RESUME NORMAL RATE OF DESCENT.
NORTHERN 340—ROGER. WE HAVE THE RUNWAY IN SIGHT.

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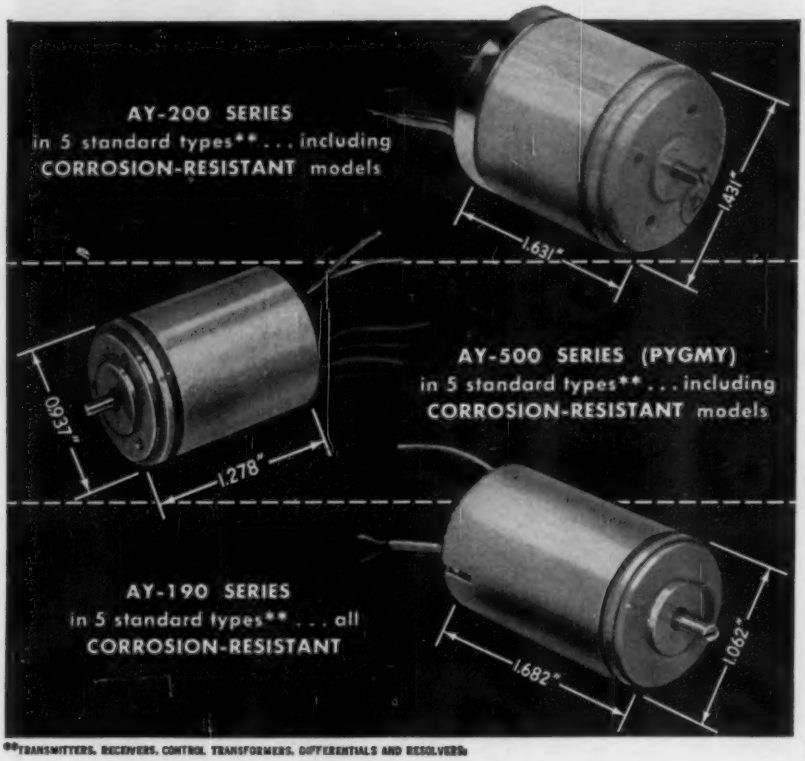

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West Coast Office: 117 E. Providencia Ave., Burbank, Calif.
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York, brass sheet, 35,181 lb., $25,849.

Reynolds Metals Co., 2500 South Third St., Louisville, alum. alloy, sheet, 256,267 lb., $110,912.

Stratoflex, Inc., P.O. Box 10398, Fort Worth, Tex., fittings, end, 72,575 ea., $31,860.

Ellwood Ivins Steel Tube Works, Inc., Oaklane, Philadelphia 26, steel tubing, 37,729 lb., $28,470.

General Metals Corp., Adel Div., 1444 Washington Ave., Huntington, W. Va., clamp, clip, 266,785 ea., $29,271.

Handy and Harman, 82 Fulton St., New York, anodes, silver, high purity, 250,000 troy oz., $220,625.

Pacific Tube Co., 5710 Smithway, Los Angeles 22, steel tubing, 115,633 lb., $29,526.

Rohm and Haas Co., 222 W. Washington Square, Philadelphia 5, plastic sheet, 4,755 sheets, $70,183.

The following contract awards were recently announced by Oklahoma City Air Materiel Area, Tinker AFB.

Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif., bladder assys., 8 items, $127,829.

Bendix Aviation Corp., Bendix Drive & RR, South Bend 20, Ind., modification of fuel control TJ-L1, 165 ea., $198,000; valves, 91 ea., $41,352.

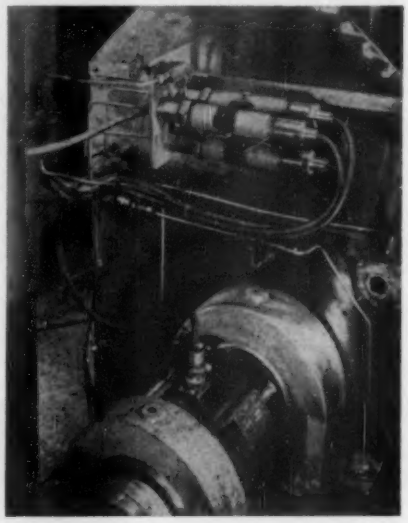
Line Construction Co., P. O. Box 351, 705 S. Walnut, Hutchinson, Kan., repair of overhead elec. distr. system, $56,742.

Lockheed Aircraft Corp., Marietta, Ga., modification of B-47 acft., 20 ea., $263,638.

Mid-America Paint & Flooring Co., 105 Midwest City, Okla., repair & overhaul of runway lights and cables, $29,773.

Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, valve assys., 2 items, $26,645.

Quick Charge, Inc., 1750 N. E. 10th St., Oklahoma City, modification of J-47 exhaust cones, 4,845 ea., $226,711.



J65 Starters Tested Here

To supply accurate remote records of operating characteristics of turbine-type fuel-air combustion starters for Wright J65 turbojets, Bendix Aviation Corp., Utica, N. Y., is using Baldwin SR-4 pressure cells (top) and a Baldwin SR-4 torque pickup (bottom) for the necessary 3.5-sec. tests. Resistance wire strain gages in these devices transmit to central recorders impulses that note the variations in starter torque, combustion chamber pressure, fuel and air pressures. Bendix has five test stands with this equipment, supplied by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

J. L. ADRIAN, CHIEF PROPELLER DESIGN ENGINEER, PROPELLER DIVISION, CURTISS-WRIGHT CORPORATION, CALDWELL, N. J.

G-E aircraft motors meet C-W's toughest specs

"When Curtiss-Wright was developing its now famous Electric Propeller," says J. L. Adrian, Chief Propeller Design Engineer of the company's Propeller Division, "it faced very strict design requirements. For instance, C-W needed a propeller pitch-changing motor that would function with precision under the rigors of combat military service—extremes of altitude, temperature, vibration, shock, and centrifugal force.

"Then G-E engineers were called in. They came through with a basic motor design that not only met Curtiss-Wright's toughest specifications but, with variations, has been used in 55 different Curtiss Propeller applications since—on such planes as the B-50 Superfortresses, C-124 Globemasters, and DC-6, CV-240, and Constellation transports."

IN SERVING YOU, G-E engineers can draw on unmatched experience gained in solving this and many hundreds of other aircraft motor problems. In addition, they'll have at their disposal complete aircraft motor development and testing facilities.

To take full advantage of this service, contact your local G-E Apparatus Sales Office ***early in your planning***. And, for more information, write today to Section 704-30, General Electric Co., Schenectady 5, N. Y.

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GENERAL ELECTRIC

Douglas B-66 takes off for test run. Defense includes G-E armament system shown in photo above.

B-66 is first tactical bomber with radar controlled defensive armament system

The U.S. Air Force's latest twin jet bomber, the Douglas B-66 will be the first tactical bomber defended with General Electric's MD-1 fire control system. First flown in June last year, the B-66 is capable of carrying atomic bombs.

Like other G-E designed and produced defensive armament systems currently in operation, the new B-66 system is composed of control equipment, and a tail turret mounting two guns.

PROVIDES AUTOMATIC PROTECTION

A similar system, now installed on the B-47, operates as follows in performing these functions as a "packaged" tail defense.

- Automatically warns the gunner on an enlarged radar screen of approaching aircraft.
- Automatically tracks and positions the guns on selected target by means of radar.
- Continuously supplies windage, ballistics and lead corrections by means of an electric computing network.
- Fires guns electrically under control of the gunner.

HOW SYSTEM OPERATES

Briefly, here's how the system operates: When the B-47 enters a danger area, the gunner switches the radar to "search" and adjusts the system control panel to provide the computer with air temperature, altitude and air speed information.

When the radar picks up an attacking plane, a bright spot shows on the screen. By means of a control handle, the gunner easily moves the radar antenna until it is centered on the target. Once the target is "acquired" and the radar is "locked on," the target is tracked automatically.

Radar then supplies the computer with the position and range of the attacking plane. Necessary gun deflections and corrections are computed automatically. When the hostile aircraft enters gun range, the gunner presses a trigger which fires the guns electrically.

If you would like more information on the MD-1 fire control system and are cleared to receive classified data, contact your nearest G-E Apparatus Sales representative.

General Electric Flowmeter includes l. to r. power supply, indicator, and transmitter.

Mass flowmeter system aids pilot two ways

Why measure the mass of fuel? The heat content of jet engine fuel is based upon the weight rather than the volume. This means that the specific gravity varies widely with the type of fuel and the temperature. Only a measurement of the actual mass of the fuel being used at the time it is being used can give you an accurate measurement of the fuel consumption. A measurement of the volume of fuel flow allows a varying degree of error dependent upon the specific gravity of the fuel being used.

MEASURES RATES OF FUEL USED

G.E.'s mass flowmeter systems provide an individual or total rate indication for one to eight jet engines and aid the pilot or flight engineer two ways:

1. Simplifies the computation of total fuel remaining.

2. Permits a running evaluation of engine operating efficiency through comparison with the pilot's other "experience data" (altitude, flight, speed, etc.). In addition, a total rate signal may be fed into automatic cruise control systems.

For more information on how this system aids pilot and plane designer, check "A" on coupon for bulletin GEC-932.

Direct engine pad mounting is permitted by the small outline and light weight of the General Electric ball piston drive. The a-c generator is coupled directly to the drive.

Smallest and lightest A-bomber yet revealed, the Douglas A4D Skyhawk uses the General Electric 9 KVA ball piston constant speed drive.

G-E constant speed drive selected for bantam A-bomber

Requiring high performance, plus an extra weight and space reduction on the design of the A4D, Douglas chose the General Electric 9 KVA ball piston constant speed drive for a-c power supply.

The flexible nature of the G-E drive permitted incorporation of an engine starter adapter, and furnished engine starting and a-c power generation from a single pad. More reliable performance is provided by the simple mechanical operation and small number of rotating parts of the ball piston units.

For detailed information on how the G-E ball piston drive can be designed for your specific needs, contact your nearest G-E Apparatus Sales Office.

Send coupon below, and check "C" for a new bulletin, describing the many features of the G-E hydraulic constant speed drive.

New right angle lead capacitors are specially designed for printed circuits

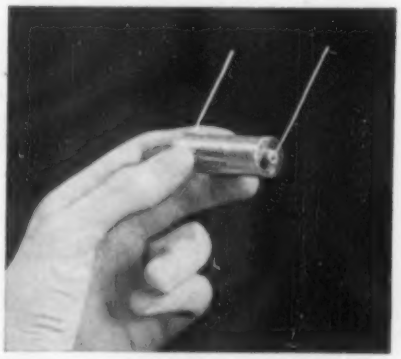
These subminiature metal-clad tubular capacitors with right angle leads are new additions to General Electric's subminiature line. The leads are welded to the silicone bushing stud at right angles rather than axially.

Especially suitable for printed circuit applications, the dimension between leads can be determined accurately for each case size required with assurance that every metal-clad tubular received will be within close specified manufacturing tolerances.

Because the leads do not have to be bent during assembly, there is less chance of breakage and leakage. The welded "right angle" leads will withstand the same rigorous shock, vibration and pull requirements as the axial leads.

These right angle lead capacitors are available in a full range of ratings for 85° C and 125° C operation.

Check "B" in coupon to receive GEC-987A for further information on this new line.



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- ☐ "B" Subminiature Metal-clad Capacitors, GEC-987A
- ☐ "C" Hydraulic Constant Speed Drive, GEA-5979

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ARC 15D Omni is compact, lightweight, CAA certified, and now employs new course indicator which combines course selector and cross-pointer meter in a single space-saving unit.

Lighten the load with ARC DUAL omni. Specification data sent on request.

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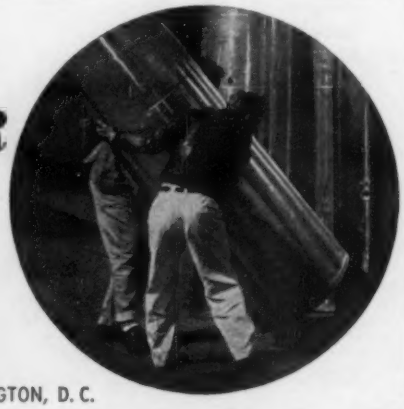

ROSEMEAD, CALIF. DAYTON, OHIO WASHINGTON, D. C.

Martin Gets $5 Million To Develop XP6M-1

A $5-million contract for research and development work on the XP6M-1 SeaMaster has been awarded to Glenn L. Martin Co., Baltimore, by the Navy's Bureau of Aeronautics.

The XP6M-1, a four-jet seaplane designed for mine laying and reconnaissance, is scheduled to start flight tests this spring (AVIATION WEEK Jan. 10, p. 16).

Other recent Navy contracts:

Computer-Control Co., Inc., Wellesley, Mass., research and development, $347,696.

Douglas Aircraft Co., El Segundo, Calif., spare parts, $343,113.

McDonnell Aircraft Corp., St. Louis, kits of parts (two contracts), $295,640.

Texas Instrument Co., Dallas, instrumentation, F7U-3 aircraft, $100,000.

Grumman Aircraft Engineering Corp., Bethpage, N. Y., spare parts, $252,631.

Chance Vought Aircraft, Inc., Dallas, research and development, $301,910.

Boeing Airplane Co., Seattle, design, develop and test components for improved Boeing 502 gas turbine engine, $172,652.

ARDC Contracts

The following contracts have been announced recently by Headquarters, Air Research and Development Command, Baltimore 3, Md.

FRANKLIN INSTITUTE of the STATE of PENNSYLVANIA, 20th & Parkway, Philadelphia 3, continuation and extension of research to include a study of purification and substructure formation of metals and semiconductors and the properties of high-purity metals, $33,821.

REGENTS of the UNIVERSITY of CALIFORNIA, Berkeley 4, research and reports on effect of acute traumatic injury on blood lipid and lipoprotein levels of human casualties at various intervals after injury, $67,741.

PENNSYLVANIA SALT MANUFACTURING CO., Wyndmoor, Pa., addition of funds and continuation of studies of properties of liquid fluorine, nitrogen and perchloryl fluorides and the oxygen-fluorine system, $39,424.

REGENTS of the UNIVERSITY of MICHIGAN, Ann Arbor, Mich., research on heat transfer and mass transfer between a porous surface and an adjacent airstream, $25,000.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y., research on utilization of energy stored in the upper atmosphere, $26,570.

REGENTS of the UNIVERSITY of MINNESOTA, Minneapolis 14, theoretical and experimental studies of mass transfer cooling, $59,834.

TEST RESEARCH SERVICE, INC., 12 Normandy Md., Bronxville, N. Y., development of test items for use in aircrew and other officer selection and classification devices, job, $31,177.

CORNELL AERONAUTICAL LAB, 4455 Genesee St., Buffalo, N. Y., research and reports on rate of highspeed reactions (P.R. No. 199163), $34,655.

ECLIPSE PIONEER DIV., Bendix Aviation Corp., Teterboro, N. J., technical evaluation of the Intavex (Dudenhausen) two-axis automatic pilot (P. R. No. 586270), $50,000.

McGRAW-HILL PUBLISHING CO., 330 W. 42nd St., New York, N. Y., research survey and reports relating to human factors (P. R. No. 175706), $55,840.

MOUNT ZION HOSPITAL, San Francisco, Calif., studies and reports of the regional distribution of blood flow and blood volume, cephalic measurements (P. R. No. 586721), $25,800.

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HIGHER PAYLOADS *and* HIGHER PERFORMANCE

This compact, light-weight rocket powerplant, designated by the U.S. Air Force as the LR63-AJ-1 liquid-propellant rocket, has been successfully flight-tested on the Republic F-84F airplane. Used for assisted-takeoff, this powerplant and its big brother, the YLR45-AJ-1, which was extensively flight-tested on Boeing's B-47B Stratojet during 1954, have proved the practical application of rocket power to piloted aircraft.

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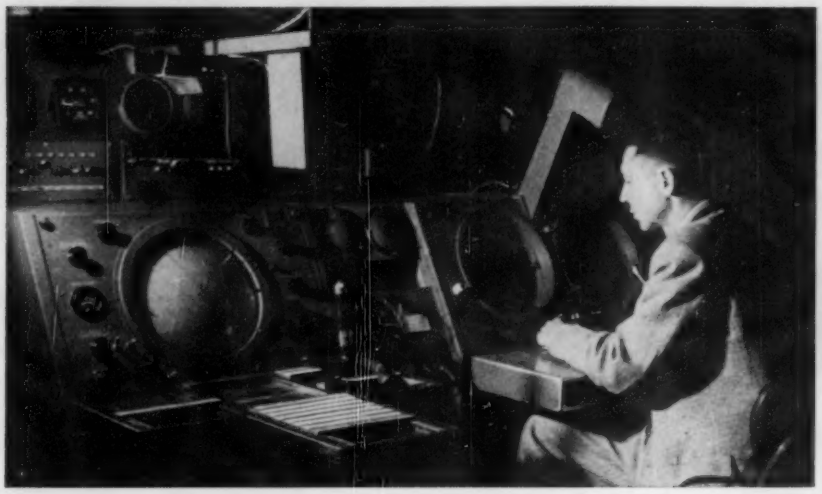
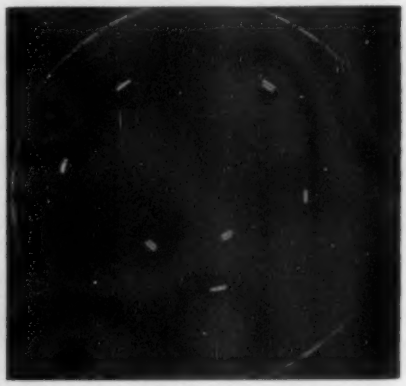




RADAR BEACONS will enable traffic controllers to distinguish between planes headed for different airports by displaying them as single or double blips.

Radar Beacons To Speed Traffic Flow

By Philip Klass

The radar transponder beacon program, one of the brightest hopes for solving many of today's pressing traffic control problems, particularly in the terminal area, is racing along in high gear. Within the past several weeks, representatives of 31 scheduled airlines meeting at Indianapolis agreed to equip their fleets with beacons, a program involving a $5-million expenditure (AVIATION WEEK Feb. 7, p. 7).

Equally encouraging is the fact that all interested military and civil air carrier agencies appear to be in complete (and cordial) agreement on a Common System device which will enable all transponder-equipped aircraft, military and civil, to show up and be identified on both civil and military radar scopes.

Observers generally agree that the Air Navigation Development Board, which set up a special committee of civil and military representatives to expedite the program, deserves a big share of the credit for the beacon's present status. Barring unforeseen snags, fleetwide installations of the 25-30 lb. transponders should be in service by 1956-57, qualified observers estimate.

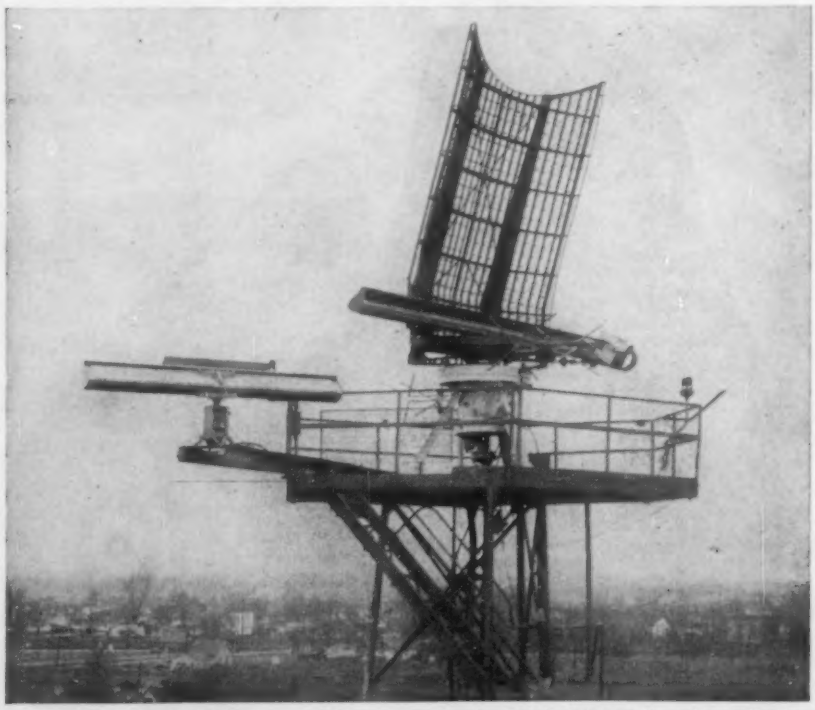
▶ **How Transponders Pay Off**—Based on military experience, and tests by the Civil Aeronautics Administration on experimental beacon systems, there is convincing evidence that implementation of the beacon program will:

• **Provide positive aircraft identification,** instantaneously and continuously, on radar scopes without need for delaying maneuvers now required to identify individual aircraft. This continuous identification feature should greatly speed traffic flow in congested terminal areas such as New York.

• **Assure strong radar echo** from piston or jet aircraft out to ranges of 200 miles when new long-distance radars are installed for en route traffic control. (Without props, which make good radar reflectors, jets provide weaker return unless equipped with transponders.

• **Eliminate precipitation clutter,** which often makes surveillance radar ineffective during heavy rain or snow storms, when most needed. Under such conditions, controllers are now forced to abandon use of radar control procedures, which requires them to increase the approach intervals by a factor of two to three.

• **Eliminate "blind speed" phenomenon,** resulting from use of MTI (moving target indication), which under certain conditions and aircraft speeds can



TWO TYPES OF BEACON interrogator antennas under test include 18-ft. unit attached to lower portion of regular ASR antenna (r.) and 9-ft. antenna mounted on an outrigger.

Friend or Foe?

RADAR is the central nervous system in today's supersonic planes. It identifies friend or foe; it flies the plane; it scans the skies; it fires the guns; it directs the landing. Stewart-Warner Electric is developing new techniques to meet all the requirements of rapidly expanding electronic devices and equipments.

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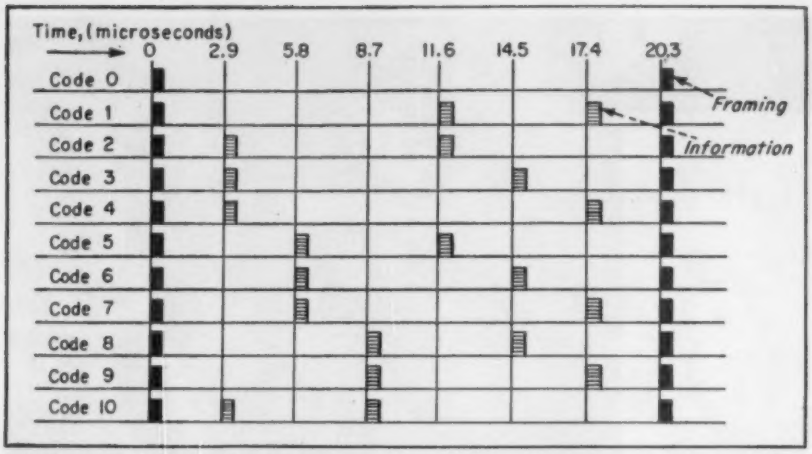
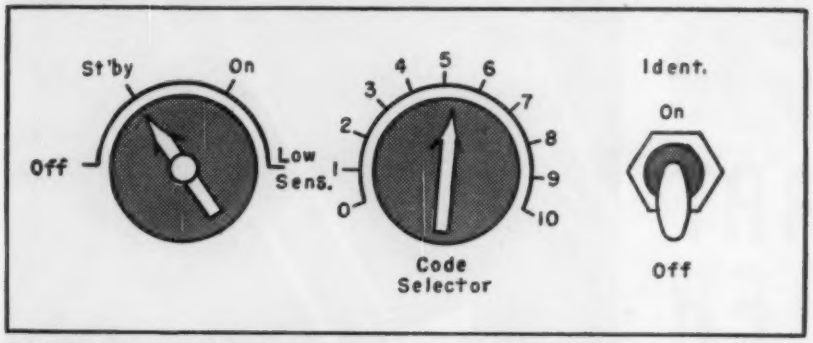


BEACON REPLY, except for code Zero, consists of two framing and two information pulses.



CONTROL PANEL enables pilot to select desired reply code, give "bloomer" identification.

cause a plane to disappear momentarily from the radar scope.

► **Everybody Cooperates**—Here is a roundup of recent moves by civil, military, and industry groups which indicates how the beacon program is coming:

• **Civil Aeronautics Administration** has announced plans to install ground beacon equipment (called "secondary radar") at five major airports this year for operation by early 1956 (AVIATION WEEK Jan. 31, p. 11). Installations are slated to go in at LaGuardia, N. Y. International (Idlewild), Newark, Washington, and Chicago.

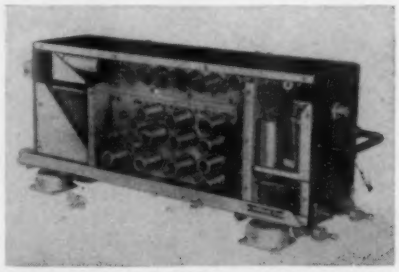
CAA action followed on the heels of an Air Transport Assn. letter in October which assured the CAA that "the airlines are solidly behind the ATC (Air Traffic Control) radar beacon system." ATA went on to say that if CAA would install the necessary ground beacon equipment at these major airports, many of the carriers operating into these areas would install transponders in their aircraft.

• **Defense Department,** at the recent ATA meeting, repeated earlier assurances that it intends to quickly implement its end of the program. "By the time the airlines can equip with transponders . . . both military aircraft and military surveillance radars will be radar beacon equipped," Defense says. It adds that "a number of equipped military aircraft are already showing up on the (CAA) Technical Development Evaluation Centers' Indianapolis radar beacon system" currently undergoing test there.

• **Air Transport Assn.** has equipped Lake Central Airlines' fleet of six DC-3s with transponders (made by Melpar) for ANDB-sponsored tests (AVIATION WEEK Nov. 8, 1954, p. 11). LCA operates into Indianapolis, and into Dayton where USAF has compatible surveillance radar in use.

The Air Defense Command, in complimenting LCA on the move, says that as a result "ADC will be able to track (LCA) aircraft regardless of weather, that better identification will result, and that better weather advisory service can be rendered. . . ."

• **Arinc's Airline Electronic Engineering Committee** (AEEC) has worked out, and last week approved, a specification covering airline-type transponder equipments.



MELPAR airborne transponder weighs 27 lb., comes in ½ ATR case.

Although the spec is not formally released yet, in its present form it enables avionics manufacturers to proceed with their transponder design and development. AEEC has tried to relax tolerances wherever possible, consistent with Common System compatibility, to keep equipment costs down. (ATA has advised the airlines to budget approximately $2,500 for a transponder, including installation costs.)

• **Several avionics manufacturers,** including Melpar, Bendix Radio, Hazeltine and Collins Radio are designing transponders for airline and business aircraft use.

Narco may enter the field, possibly with both an airline model and one aimed at the smaller private planes, a spokesman told AVIATION WEEK.

Flyable prototypes of the transponders should be available from several manufacturers sometime this summer, observers estimate.

• **ANDB's special beacon committee** will explore possible ways of coming up with a low-cost transponder, or equivalent, during the coming year for use by private flyers, a spokesman reports. ANDB has budgeted funds for work along this line.

► **How the System Works**—Simply stated, the ATC transponder is a small airborne radar receiver-transmitter-coder, not unlike the IFF (identification friend or foe) beacons which have been used on military aircraft. The transponder is expected to weigh about 25-30 lb., to be packaged in a ½ ATR-size case.

To interrogate the airborne transponders, an auxiliary radar (secondary radar) operating at L-band (approximately 1,000 mc.) is installed on the ground in conjunction with the existing ASR (primary radar) which operates at S-band (2,800 mc.) The secondary radar antenna may be mounted on the same pedestal as the ASR dish, or located remotely and operated synchronously. Another possibility under investigation is to mount the secondary radar antenna on a small outrigger installed on the ASR tower.

As the ASR antenna rotates, beaming out its regular S-band pulses, the secondary radar sends out a series of specially coded pulses at a lower repetition rate. When these are received by the airborne transponder, and identified as coming from a secondary radar interrogation, the transponder triggers its transmitter to reply with one of a number of pulse codes selected by the pilot. The present Arinc design provides 10 different codes, plus one basic "codeless" reply. The choice of code might, for instance, be selected to indicate the

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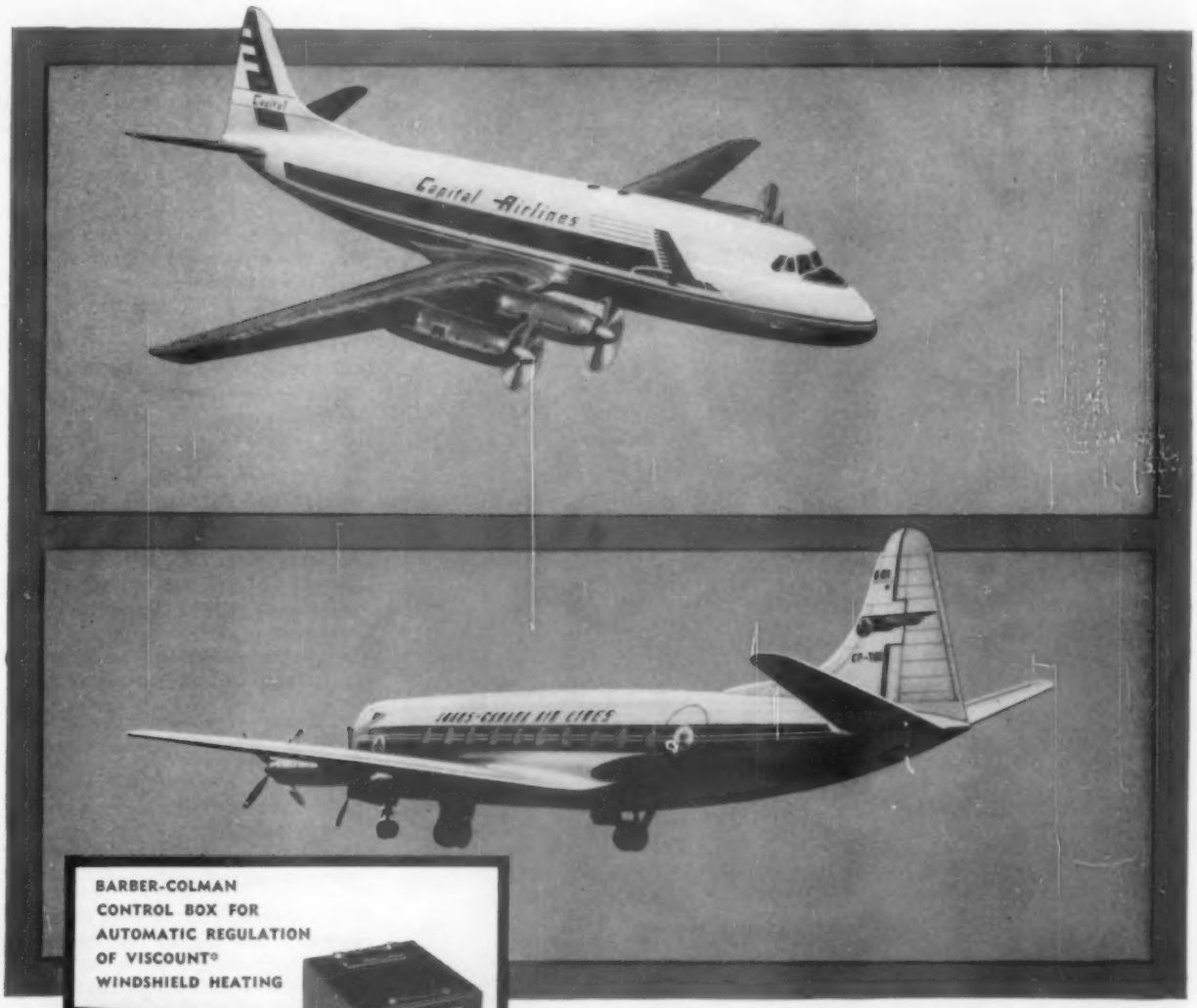
Clear vision for pilots will be assured by a Barber-Colman automatic control system on the new turboprop powered Viscounts of Capital Airlines and Trans-Canada Air Lines. The on-off control maintains correct temperature of the electrically heated windshields by cycling the supply power to the conducting oxide film of the glass. The operating signal is produced by temperature variations at the wire grid sensing element molded into the vinyl layer of the windshield panel. This standard d-c control circuit has been previously applied to a multitude of similar applications on military and commercial aircraft such as cabin or camera compartment temperature control and remote positioning of valve actuators and trim tabs.



BARBER-COLMAN CONTROL BOX FOR AUTOMATIC REGULATION OF VISCOUNT* WINDSHIELD HEATING

*On Capital Airlines and TCA

The complete line of Barber-Colman aircraft controls includes: Valves; Positioning Controls; Actuators; Temperature Controls; Small Motors; Ultra-Sensitive Relays; Thermo-Sensitive Elements. Write for catalog F-4141-1. Engineering sales offices in Los Angeles, Seattle, Baltimore, New York, Montreal.

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He's a proud man...and he has a right to be. Not everybody can be a Navy flier. Not everybody can graduate to wear glistening wings of gold and the stripes of a Navy Ensign.

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Private money can't buy it. But the Navy gives it to those who qualify. It costs about $70,000 to build a Navy flier...and when a man graduates... he's ready to wear that $70,000 hat.

He's equipped to man the newest Navy jets. He's learned to live by Navy's strict code of safety...both in aircraft and on the ground. He's an Air Navy man...and America is proud of him.

America needs more men like him now!

Men who can carry responsibility... who want to take their place in the new jet age. Men who want to take hold of their future and give it direction. Men who can wear a $70,000 hat. Men like yourself, perhaps?

If you are single and between the ages of 18 and 25, visit your nearest Naval Air Station, or fill in the coupon below and send to: NAVCAD, Washington 25, D.C.

NAVCAD CV-2
WASHINGTON 25, D. C.

Gentlemen:

I want to be a Navy flier. Please send me the complete story on Naval Aviation and the qualifications I must meet for Flight Training.

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plane's destination, or point of origin.

► **Variety of Displays Possible**—When the transponder's coded reply is received on the ground, it is automatically decoded and superimposed on the same scope showing aircraft blips received by the primary ASR. Decoders can be designed to display and distinguish between individual codes in a variety of ways, eventually perhaps with a different colored scope blip for each code. Chromatic Television Labs recently demonstrated such a color radar scope presentation.

In one possible mode of operation, control tower radar operators at each of several locations in a multi-airport area could set their individual decoders so that all aircraft destined for their particular airport would be displayed on their scope as a "double blip" while all other aircraft appear as single blips (see photo, p. 70).

Thanks to cooperative military-industry planning, the present Arinc transponder design has sufficient versatility to permit the number of reply codes to be increased from 11 to 64, and to permit the transponder to be discriminately responsive to several different ground interrogation codes.

Thus, at some later date it should be possible for the transponder to perform added functions. For instance the beacon system could transmit and display automatically an airplane's barometric altitude as well as its particular identification. However, this is off in the future.

► **Simple to Use**—The pilot need not master any new operational techniques to use the transponder. His cockpit control panel contains only three switches (see sketch, p. 72).

One is the familiar off-standby-on switch, with an extra position which cuts receiver sensitivity by 30 db. for close-in operations, if so requested by the controller.

A second switch enables the pilot to select any one of the 11 codes, as assigned, or per instructions from the ground controller.

The third button or switch is momentarily pushed by the pilot when the ground controller asks him to identify himself. When pushed, it causes the transponder to transmit a specific one of the 11 codes, which will always be used for this purpose. This will cause the blip on the ground radar scope to "bloom" to several times its normal depth for approximately 6 seconds (or longer if desired).

► **Transponder Details**—The ATC transponder is designed to accept coded ground interrogations at a frequency of 1,030 mc., and to reply on 1,090 mc. The basic interrogation consists of a pair of pulses, of 0.7 to 1.2-microsecond duration, which are spaced approximately eight microseconds apart.

The Arinc spec calls for the transponder to operate at an interrogation rate of 60 to 2,000/second. The high rate assures that the transponder will be able to reply to interrogations from a number of ground radars in a multi-airport area.

The transponder reply consists of two framing pulses, 0.35 to 0.55 microseconds in duration, spaced 20.3 microseconds apart, plus two information pulses spaced at assigned multiples of 2.9 microseconds from the first framing pulse (see sketch, p. 72). Ten of the reply codes, numbered one through 10, consist of the two framing pulses and two information pulses. Code zero consists solely of the framing pulses. The transponder transmitter is to have a peak pulse power of 500 watts, according to the Arinc spec.

► **PAR Provisions**—The Arinc transponder is to be designed so that the addition of an external X-band receiver at some later date will enable the beacon to reply to interrogations from a precision approach radar (PAR) as well as to an ASR secondary radar.

Although identification of individual aircraft and reinforcing the normal radar echo are not as pressing a need for PARs as for ASRs (because of the shorter ranges at which the PAR is used), this feature might prove a useful addition for future traffic densities.

► **Technical Problems Remain**—There are still some technical problems which must be resolved before widespread civil implementation can take place.

One of these is the question of how big a secondary radar antenna dish can be accommodated and where it should be mounted. For reasons of economy, CAA would like to mount the secondary radar dish on the present ASR tower, or use the existing 10-ft.-wide ASR dish. If a separate secondary radar dish is added, it probably will be limited to 10 ft. in width to prevent imposing undue wind loads on the tower.

However, because the secondary radar operates at a lower frequency, the resulting beam will be nearly three times as wide as that of the primary ASR, giving poorer resolution. With a 10-ft. antenna dish, two transponder-equipped aircraft flying at the same altitude 30 miles out must have a lateral separation of at least eight miles to show up as separate targets on the controller's radar scope.

One way around this problem is to use a 20-ft. secondary radar dish, but this raises the problem of antenna wind loads.

An alternative is to install the 20-ft. dish on a separate tower and operate it remotely, but this involves added cost. With the 20-ft. dish, the aircraft separation at 30 miles would need to be only four miles. CAA's TDEC currently is investigating this entire problem.

Ground and airborne equipment under test at TDEC has come from a number of participating firms.

These include: Stewart-Warner, General Communications Co., Capehart-Farnsworth, Maryland Electronics, Hazeltine, and Airborne Instruments Lab.

► **Which Aircraft?**—Another problem which is getting attention is that of designing the ground decoder so that it will not be confused by pulses from different aircraft in the area. For instance, the decoder must not mistake an initial framing pulse from one airplane transponder for an information pulse from another aircraft transponder. This problem appears susceptible to solution, but at some expense in increasing the complexity of the ground decoder.

There may be other problems that will arise before the beacon program is fully implemented. However, the potential gain from the use of beacons appears to overshadow by far any fear of such problems in the minds of most qualified observers.

At least one traffic control expert believes that radar beacons are going to be the "biggest boon to air traffic control since radar came into use."

Man-Made Radar Isle

This is a model of a radar station to be anchored about 100 mi. off the New England coast to guard against surprise air attack. The three domes are part of the air search radar equipment; and 200-ft. triangular platform will have provision for a heliport. Navy, acting for USAF, has announced a $5-10-million contract for construction of such a station at Bethlehem Shipbuilding Co., Quincy, Mass. Anderson-Nichols & Co. (Boston) and Moran, Proctor, Mueser & Rutledge (N. Y.) have been awarded $600,000 in contracts to prepare plans and specs for five "Texas Towers" (TT-1, 2, 3, 4 and 5) for installation at various locations.

C. H. Fish, design engineer assigned to the Icing Research Tunnel, measures impingement limits of ice on C-130 wing section. The tunnel has a temperature range of −40°F. to +150°F. and maximum speed of more than 270 mph.

Lockheed Increases Thermodynamics Staff

With six prototypes now in flight, Lockheed's Thermodynamics Department is expanding its staff to handle greatly increased research and development on future aircraft in commercial and military fields.

Lockheed's new icing tunnel, designed and installed to help handle the increased work load, is already in operation. It is the first icing research tunnel in private industry, and gives Lockheed's Thermodynamics Department unmatched testing facilities.

The tunnel enables Lockheed thermodynamics scientists to study in greater detail such problems as: thermal anti-icing; cyclic de-icing; various methods of ice removal; distribution of ice; rate of temperature changes in aircraft components; thermodynamic correlation between laboratory and flight testing; and development and calibration of special instrumentation.

Thermodynamics Career Opportunities—A number of new positions have been created by Lockheed's diversified expansion program. Thermodynamics assignments include such diverse projects as nuclear energy; supersonic fighters, trainers and transports; advanced versions of vertical-rising aircraft and bombers; turbo-prop transports; and a number of significant classified activities.

Lockheed offers you increased salary rates now in effect; generous travel and moving allowances; an opportunity to enjoy Southern California life; and an extremely wide range of employee benefits which add approximately 14% to each engineer's salary in the form of insurance, retirement pension, sick leave with pay, etc.

You are invited to write E. W. Des Lauriers, Dept AW-T-2, for a brochure describing life and work at Lockheed and an application blank.

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AMC Asks Switch to More-Reliable Tubes

The Air Materiel Command has asked its avionics suppliers to change over all existing and future equipments to use new improved "military control tubes" in place of older, less-reliable types, in a move aimed at boosting the reliability of avionic equipment.

The new policy will apply initially only to airborne equipments, but later will be extended to include such ground equipments as radar and communications sets. The 12 electron tube types now available are expected to fill more than 80% of USAF's tube requirements.

Military control tubes are purchased under a procurement specification which sets up minimum acceptable quality standards and carefully specifies testing and sampling procedures which tube makers are to use.

▶ **Goal: Steady Tube Production**—AMC is considering setting up a $25-million tube procurement program, spread over the maximum legal 22-month period to enable tube manufacturers to plan their production more efficiently.

Object is to enable tube makers to retain their skilled personnel and avoid the necessity of starting up and shutting down production on individual tube types. End result would be higher-quality tubes with lower factory rejection and field failure rates, AMC believes.

Recommendation for the $25-million planned tube production program was made by a recently formed electron tube advisory panel which serves as a consultant to the AMC's Electron Tube Management Group. The ETM Group is made up of 25 representatives of USAF agencies concerned with procurement, supply, distribution, and development of tubes.

AMC's Lt. Col. Tom L. Barrow is chairman. The advisory panel consists of representatives of four tube makers, four avionic equipment firms and the Radio-Electronics-Television Manufacturers Assn.

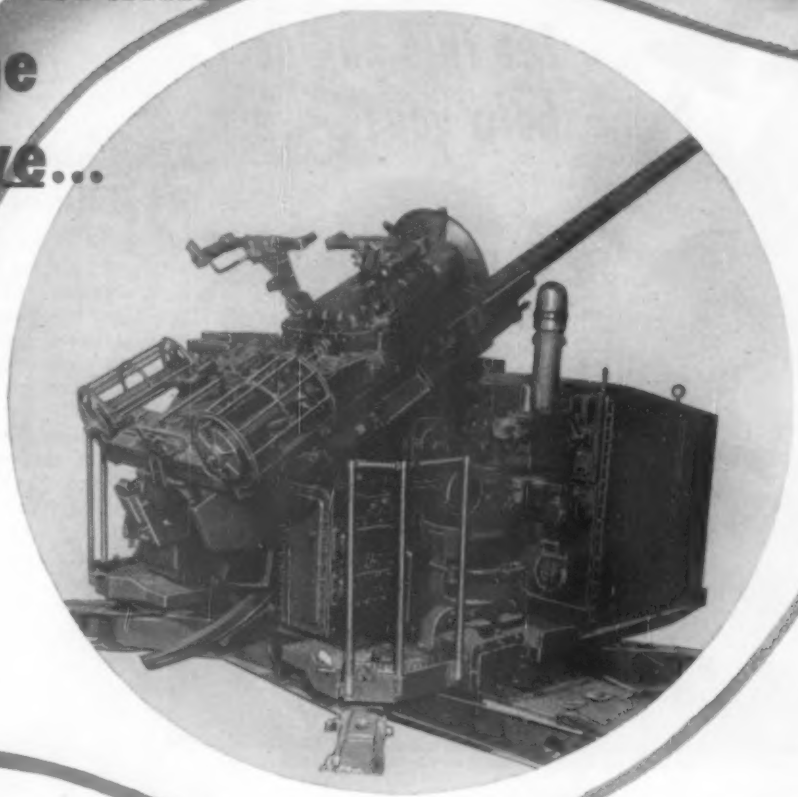
▶ **Shopping Lists**—As an interim measure, the Air Force plans to determine and publish estimates of the number of tubes of various types that will be required by avionic equipment manufacturers and by the Air Force for its own spares.

Another similar step, already under way, is the publication by Gentile AF Depot of monthly "shopping lists" of tube types which it plans to buy in succeeding months.

▶ **Conversion Under Way**—Avionic equipment manufacturers holding AMC contracts have been requested to change over to the new MC tubes.

In most cases, this is easily accomplished because the operating charac-

AC builds brains for the Big Eye...

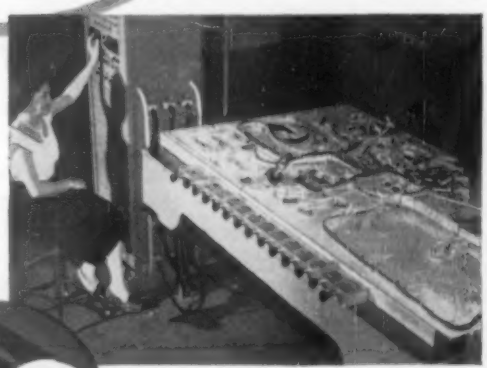


At strategic spots throughout the country you'll find them—the "big eyes" of America's defense. What are they? These T-38 Skysweepers are radar "eyes" that automatically sweep our skies in a never-ending vigil.

The "brains" are fire control units—one of the most important electro-mechanical devices yet developed—which can spot, track and fire at any planes within their line of sight.

AC is proud of its contributions to development of the "big eye," and proud of the AC mark stamped on these complex units.

This is just one more example of AC's demonstrated ability in the electro-mechanical field. Do you have a problem of this nature? Let AC lend a hand. Why not give them a call now?



This AC-developed machine reduced test time from 40 hours to 2 hours per unit

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teristics of the new tubes are identical or very similar to the earlier types. Where the switchover cannot be made without extensive equipment modification, the contractor may request a deviation. However, Col. Barrow reports that only one contractor has made such a request to date, and he hopes that even this one will not prove necessary.

USAF has launched also a field retrofit program aimed at substituting MC tubes for less reliable counterparts in equipments in operational use.

Controller Stretches Life of Radar Tubes

A new device that increases the life of airborne radar magnetrons by maintaining their filaments at proper operating temperature, has been developed by General Electric. It is one of several recently announced devices of interest to microwave equipment designers.

The new magnetron filament temperature controller, a product of GE's light military equipment department, Utica, N. Y., automatically varies filament power to accommodate changes in magnetron filament resistance caused by RF back heat. The device uses no vacuum tubes, requires no d.c. power, and reportedly will operate with Litton magnetron types L3040, L3041, L3044, and L3045.

GE reports filament resistance regulation of ±5% with the controller under conditions of 75% RF back heat applied, ±5% variation of line voltage and frequency, over temperature range of −55C to 85C. Unit measures 5 x 5¼ x 9 in.

Other recently announced microwave components and devices include:

• **Double-ridge waveguide** that can be used for both C-band and X-band radar systems solves a dilemma for those airlines that want to include provisions for airborne storm-warning radar in aircraft under construction before they reach a decision on whether to buy C-band or X-band equipment.

The new ARA-136 waveguide, developed by Airtron, Inc., reportedly offers substantial weight and space saving com-

WAVEGUIDE for both X and C-band radar.

(Advertisement)

pared to a conventional C-band ridge

First Navy Jack, which unfurled the historic warning to the world in 1775—believed to have been first hoisted to the jackstaff of the ALFRED by one Lieut. John Paul Jones.

naval history is being made today

At 0955 on January 5th, one of the major events in naval aviation history took place.

It was the unveiling of the United States Navy's great new XP6M SeaMaster—Ship No. 1 and prototype of an entirely new concept in military aircraft.

As a component of a powerful new arm of the naval arsenal—the Seaplane Striking Force—the Martin SeaMaster focuses national attention upon a revolutionary principle of military strategy, known as the WBA* concept. Here's why:

The SeaMaster is a highly versatile 4-jet waterbased aircraft, in the over 600 MPH class, which requires no fixed base and can operate from the seas, lakes and rivers, the coastal bays, lagoons and estuaries of the world... bases unlimited!

Today the top-level talk is turning to WBA... and shown here is the reason.

*WaterBased Aircraft

MARTIN

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Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Miles,
Senior Member, Aviation Writers Assn.

By romantic legend the test pilot is a swashbuckling character with more courage than sense who leaps blithely into the cockpit of a new plane to roar aloft for a series of wild aerobatic gyrations just to see if the airplane will hang together.

Fiction — and the movies — notwithstanding, I have never met such a tester, although there may have been some long ago in the days of bamboo and baling wire.

The modern test pilot is an engineer as well as a top flyer, an aerial analyst who searches out the abilities, the frailties and the bugs of experimental aircraft in a carefully programmed series of sky studies.

His flying duties in progressive tests are only part of the job, for he must be able to recognize his plane's performance characteristics, analyze them to a certain degree, describe them for ground engineers and help in the evaluation processes.

He works according to plan in a series of scheduled test phases and mounting increments until eventually all the possibilities of a given aircraft are exhausted and complete data are at hand for the manufacturer and the buyer.

Nor can he be the helter-skelter type in this day and age, the devil-may-care pilot who wrings out an airplane exactly as he pleases. In the first place ships today are too valuable in terms of time and money. In the second, his life expectancy would be devilishly short.

Invariably he is an inherent flyer who'd rather be in the air than on the ground, his courage is the calm, steady nerve of a man who has complete faith in his skill, a faith that stems from natural ability, long hours in the air, special training in test work and the faculties of clear thought and quick action in emergencies.

Yet he has caution, too, respect for dangers that lurk in speed, power and altitude, in the menacing forces waiting in unknown phenomena.

Such are the test pilots I know — and have known — quiet, amiable men who would be the first to scoff at romantics and shrug off praise, yet men who hide within themselves a deep and justifiable pride in their accomplishments.

In the headlong rush of aviation he's the man who takes the initial risks to prove out new developments for those who follow. And now and then he loses his carefully calculated gamble.

Such men were George Welch and Joe Lynch and Charles Richbourg who gave their lives to aviation late last year; and Jim Verdin, killed recently when he bailed out of his plane during a buffet boundary test and fell some 35,000 feet without opening his 'chute. Like any other test pilot of hot, experimental jet craft, each knew — but never voiced — the fact that the next flight might be the last.

They went to work like any other businessman, turned out the day's chores and returned home to their families — until the last flight. There were no bands, no flags. There was no applause. Simply the roaring surge of power, the smoothness of flight, the deliberate test, the sudden emergency that was beyond control . . .

There have been many who died.

Reaching back in memory I can recall Al Conover and Chuck Brown whose experimental carrier bomber smashed into the sea; Ralph Virden who lost the tail of his fighter plane and catapulted to earth; John Cable who died in a late jump from a disabled light bomber.

There was Rudolph Lechner who met death in a vertical power dive that buried his ship 30 feet in spongy earth; Milo Burcham and Maj. Dick Bong, top U.S. ace in World War II, both of whom died within a year in almost the same spot; Harry Crosby, thrown clear from a whirling test jet, but falling unconscious from a blow on the head.

There was Latham Perrett whose 'chute failed to open in a last-minute jump after his crew had bailed; Howard Lilly whose research jet exploded on takeoff; George Krebs and Nick Pickard whose four-jet bomber ripped apart in midair and fell in fragments.

There have been many more over the years, their numbers increasing as research expanded, as speed and altitude and complexity scorched aircraft into new frontiers and new phenomena.

But their deaths were not in vain.

From each tragedy came some new, vital knowledge fitting into the intricate jigsaw of design and production, refinements that advanced experimental ships into production models.

Have you thought . . . without these men aviation progress would cease?

pared to a conventional C-band ridge waveguide, yet is only slightly larger than X-band plumbing. It covers a 3% bandwidth at center frequencies of 5,400 mc. and 9,300 mc. Propagation takes place in the standard T_{10} mode over the entire frequency range, company says. Waveguide measures 1.350 x 1.739 O.D.

Manufacturer's address is: Dept. A., 1103 West Elizabeth Ave., Linden, N. J.

• **High-Z miniature delay lines,** measuring only 6½ in. long and ¾ in. in dia., are available with standard time delays of 0.5, 0.7, and 0.9 microseconds, or other values on special order. Phase distortion reportedly is essentially zero below 6 mc., −2 deg. at 8 mc., and −4 deg. at 10 mc. Attenuation for 0.5 μs. is less than 1 db. at low frequencies, increasing to 3 db. at 6 mc. and 6 db. at 10 mc. Rise time reportedly is less than 7% of the time delay, with substantially zero overshoot. Useful frequency bandwidth is over 10 mc.

Manufacturer: Advance Electronics Co., Inc., 451 Highland Ave., Passaic, N. J.

Makers Extend Range Of New Transducers

A thimble-sized dynamic pressure pick-up whose natural frequency ranges upwards from 35 kc., permitting the measurement of rise times of 10 microseconds, is one of several newly announced transducers.

The new pick-up, Endveco Model

PIEZOELECTRIC element is sensor.

2501, employs a piezoelectric sensing element which eliminates need for external power. Three operating ranges are currently available: 0 to 500, 1,000, and 2,500 psi. Full-scale output for each range is 15 volts. Vibration effects reportedly are less than 0.007% full scale per G. Manufacturer is Endevco, 180 E. California St., Pasadena, Calif.

Other new transducers include:

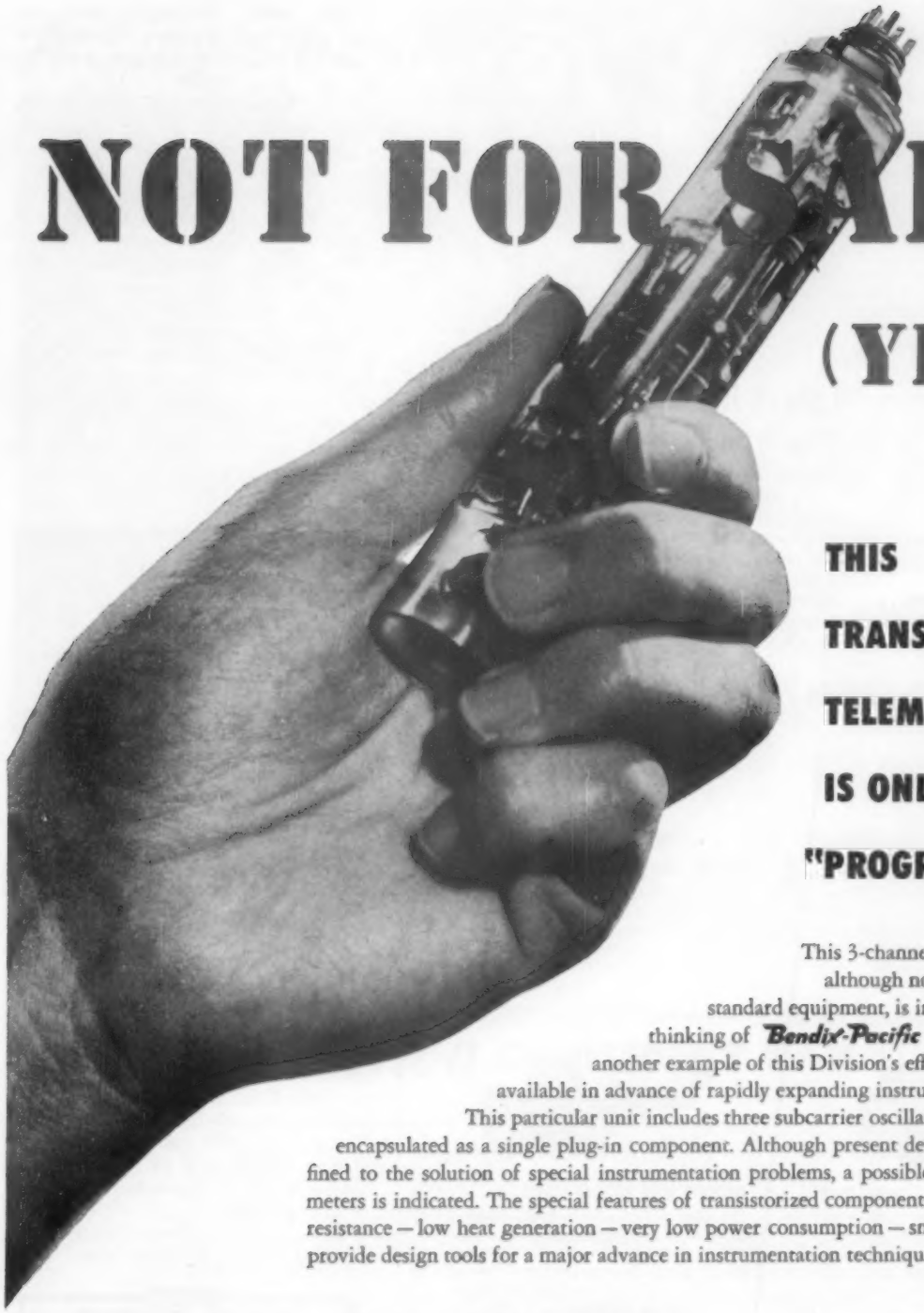
• **Wide-range accelerometer,** modified version of the National Bureau of Standards barium titanate accelerometer, reportedly has useful measurement range of 50 to 50,000G at frequencies of 10 to 40,000 cps. Model A-450 output is 0.25 mv. per G with a capacitance of 500 μμfd or higher

dependable

without cable. Sensitivity varies less than 10% over temperature range of

NOT FOR SALE!

(YET)



THIS TRANSISTORIZED TELEMETER IS ONLY A "PROGRESS REPORT"

This 3-channel transistorized telemeter although not yet available for sale as standard equipment, is indicative of the advanced thinking of ***Bendix-Pacific*** engineers and represents another example of this Division's efforts to have new designs available in advance of rapidly expanding instrumentation requirements. This particular unit includes three subcarrier oscillators and a transmitter, all encapsulated as a single plug-in component. Although present development has been confined to the solution of special instrumentation problems, a possible pattern for future telemeters is indicated. The special features of transistorized components — extremely high shock resistance — low heat generation — very low power consumption — small size — light weight — provide design tools for a major advance in instrumentation techniques.

Imagination at Bendix-Pacific today is building better products for tomorrow.

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Light "piped" throughout entire periphery of long plastic lens assures easy visibility of signal from all sides.

- Smaller, truly subminiature size
- Fully illuminated lens is clearly visible from any angle
- For either standard or edge-lit panels
- Designed to meet critical aviation performance standards

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Smaller than most subminiature lamps, yet with uniformly bright wide-angle visibility, Hetherington L6000 Series make ideal indicator or warning lights for critical military as well as many commercial applications. Using AN-3140 lamps fitted into a heavy plastic lens 27/64" long, these rugged lights are 1 1/32" overall, and mount in a 1 3/32" hole. Details in Bulletin L2.

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EDGE-LIT PANEL MOUNTING Series L2000

. . . for MIL-P-7788 panels. Sturdily constructed of nickel-plated brass with integral molded-in terminal and snug-fitting plastic lens that will not vibrate loose. Easy to mount. Write for Hetherington Bulletin L1.

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Combines exceptionally small size and light weight with durable vibration-resistant construction. Sealed against moisture. Terminal is molded into the assembly. Ask for Bulletin L1.

"PUSH-TO-TEST" INDICATORS Series L3000

Ideal for many military as well as industrial uses. Bulb is lit by pressing spring-mounted lens button. Supplied with or without silicone boot for moisture protection. Send for Hetherington Bulletin L1.

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Developed originally by Hetherington as hostess call lights, these compact little units are now available for a broad range of exacting commercial or military aircraft services. Write for Hetherington Catalog.

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without cable. Sensitivity varies less than 10% over temperature range of −40C to 90C. Unit measures ½ in. hex by 1¼ in. long and weighs 1¼ oz.

Manufacturer: Gulton Manuf. Corp., Metuchen, N. J.

• **Long-stroke linear-motion pick-off,** of the differential transformer type construction, has 10-in. stroke, measures ¾ in. in diameter and is designed for 400-cps. operation. Model 7S5 Linearsyn has output impedance under 2,000 ohms. Manufacturer is Control Components Co., 1 Holden St., Brookline 46, Mass.

• **Differential pressure transducer,** Model DP-15, is for the measurement of differential pressures of 200 to 5,000 psi. at line pressures up to 5,000 psi. Natural frequency extends from 2,000 cps. to 10,000 cps., depending on range. Response to spurious acceleration is less

RESPONSE to spurious acceleration is low.

than 0.001%/G for most sensitive axis in all ranges above 1,000 psi., according to manufacturer. Unit weighs 12 oz., can be excited with power at frequencies of 60 to 20,000 cps. Rated accuracy including linearity is 1% full scale or better.

North American Instruments Inc., 2420 N. Lake Ave., Altadena, Calif.

• **Pressure sensor,** called Baroresistor, designed for use in high-G environment, reportedly maintains its accuracy when subjected to 10G vibration at 500 cps., per MIL-E-5272A. Other models are available for missile use at 25G vibration at 0 to 2,000 cps. Units are available in the range of 14.7 to 60 psi for measurement of absolute, differential, or gage pressure.

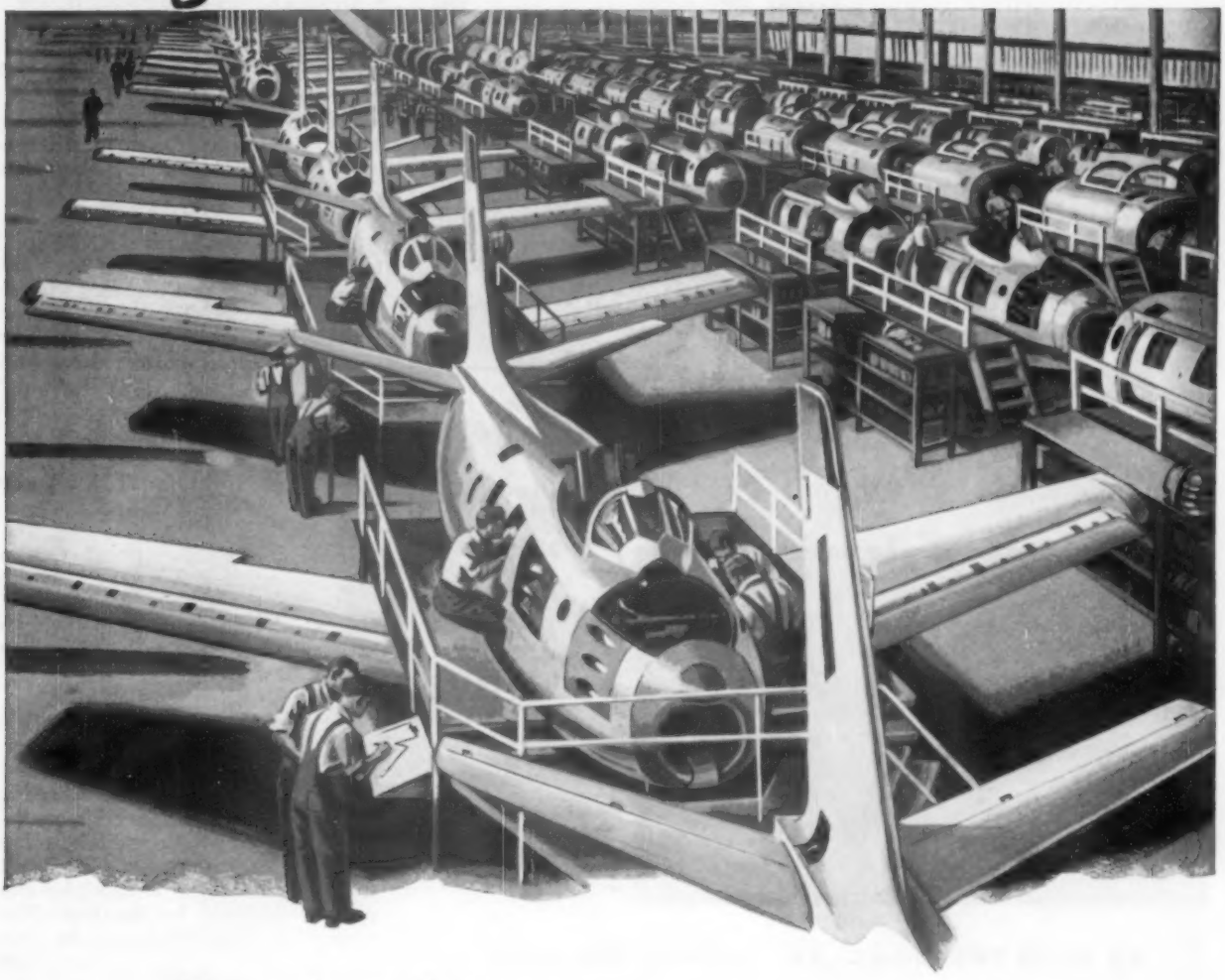
Manufacturer: Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.

FILTER CENTER

▶ **Novel Storage CRT**—Engineers involved in the airline storm-warning radar program are enthusiastic over a new simplified storage-type cathode ray tube developed by Hughes Aircraft which eliminates the need for an "erase" gun and associated circuitry normally required for storage tubes. The new HAC tube employs a phosphor which reportedly retains its full brightness for several seconds, equivalent to ¾ of an antenna

scan interval, then decays rapidly just

A Single Goal...



Production COUNTS AT CANADAIR

Enterprising management and leadership . . . astute planning . . . excellent facilities and equipment . . . the experience of its people . . . pride of accomplishment — all these factors make Canadair a leader in aircraft production.

Canadair's leadership is proven by past production of civil and military four-engined aircraft, as well as by its record of continuous production of jet fighters and trainers — and soon to appear will be a military version of the Bristol Britannia, redesigned by Canadair engineers as a reconnaissance aircraft for the R.C.A.F.

Canadair's production experience is an excellent recommendation to those buying military or commercial aircraft — another reason why people who know say "you can count on Canadair."

C-L CANADAIR LIMITED

CANADAIR

— AIRCRAFT MANUFACTURERS —

LIMITED, MONTREAL, CANADA

A subsidiary of GENERAL DYNAMICS CORPORATION, New York, N.Y. — Washington, D.C.

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DOUGLAS
AIRCRAFT COMPANY, Inc.
EL SEGUNDO DIVISION
EL SEGUNDO, CALIFORNIA

June 17, 1954

General Manager
Axelson Manufacturing Co.
P. O. Box 58335, Vernon Station
Los Angeles 58, California

Dear Associate:

Your know-how has contributed greatly to the advanced, new "Mighty Midget" A4D Skyhawk attack bomber, designed and built by Douglas for the modernized carrier fleet of the U. S. Navy.

Revolutionary techniques in engineering, tooling and producibility are incorporated in this unique defense plane, which was revealed June 7 as the smallest and lightest jet combat airplane in the United States.

To achieve the Skyhawk's engineered compactness each of its components was selected only after the most careful consideration. Your firm as a supplier may well take pride in its contribution.

Sincerely,
DOUGLAS AIRCRAFT COM
EL SEGUNDO DIVISION
C. O. Miller
Manager, Public Re

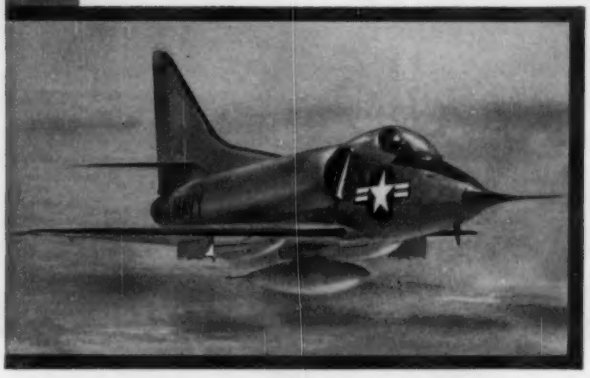

photo courtesy Douglas Aircraft Co., El Segundo Division

AS WITH THE DOUGLAS "MIGHTY MIDGET"

so, too, are Axelson's outstanding production facilities being called on by many other airframe manufacturers

Aircraft components, including landing gear shock struts, gears, geared mechanisms, segments, spars, braces and other plane structural parts are produced in Axelson's Los Angeles and Montebello plants. These facilities represent one of the Pacific Coast's best equipped and most versatile machine shops.

We would be glad to show you through or send Facilities Booklet 5037.

AXELSON *Aircraft Division*

AXELSON MANUFACTURING COMPANY
DIVISION OF U. S. INDUSTRIES, INC.
GENERAL OFFICES: P.O. BOX 58335, VERNON STA., LOS ANGELES, 58

scan interval, then decays rapidly just before new portions of the scope picture are painted.

▶ **Avionics Grows**—The Boeing B-52 will carry 6,000 lb. of avionics equipment, compared to 5,400 lb. used in the B-47, 2,100 lb. carried in the B-29, and 1,600 lb. aboard the B-17. The figures were released by Maj. Gen. Floyd B. Wood, ARDC's Deputy Commander/Technical Operations, in a talk given at a recent IRE meeting in Boston.

▶ **Avionics and Culture DO Mix**—At least three avionics firms do not agree with the old idea that engineers and culture do not mix. Westinghouse Electric's Air Arm Division is advertising for avionics engineers on the New York Times' radio station WQXR, which broadcasts long-haired music almost exclusively. Ramo-Wooldridge and Hughes Aircraft are running ads for engineers in the sophisticated New Yorker magazine.

▶ **Semi-Conductor Thyratrons?**—General Electric's research lab reportedly has found important new semiconductor effects which are analogous to thyratron or gas discharge action, the company reports.

▶ **Printed Circuits Cut Drafting**—The use of printed circuits cut drafting manhours by one third in one General Electric radar chassis and reduced the number of drawings required in another equipment by 60%, in addition to lowering manufacturing costs, GE's M. R. Johnson told a recent Philadelphia symposium sponsored by the Radio-Electronics-Television Manufacturers Assn. —PK

Avionic Bulletins

Recently announced bulletins and booklets of interest to persons in the avionics field include the following:

• **Digital converter** for changing analog inputs into a 13-binary digit output, with a maximum rate of 25,000 counts per minute, is described in 4-page bulletin available from Norden Laboratories Corp., Milford, Conn. Another company bulletin describes new synchro alignment set for zeroing 400 cps. synchros.

• **Gyromechanisms, Inc.** booklet, describes company's facilities for manufacture of gyros, potentiometers, magnetic amplifiers and hydraulic controls (12 pp). Address: Halesite, L. I., N. Y.

• **Servo systems and components,** available in standard off-the-shelf types, are described in brochure prepared by Feedback Controls, Inc., 1332 No. Henry St., Alexandria, Va.

• **Etched circuit techniques** using Kodak Photo Resist, new highspeed light-sensitive plastic coating, are described in 4-page bulletin available from Eastman Kodak Co., Graphic Arts Sales Div., Rochester 4, N. Y.

• **Expanded scale panel voltmeters** for both a.c. and d.c., including 2½-in.-dia. unit, are described in 4-page bulletin. Arga Div., Beckman Instruments, Inc., 220 Pasadena Ave., So. Pasadena, Calif.

POWER STEERING

provides faster, safer maneuverability

Loud and Haskel are pioneers in the design and development of power steering. With the advent of jet aircraft, it was necessary to provide the pilot with controls that would insure faster and safer ground maneuverability.

Loud was the originator of the first package assembly including power steering cylinder, steering control valve, shimmy damper, damping orifices, and thermal temperature compensators all in one unit assembly. Loud was the first large volume producer of this rotary output assembly steering unit, and has now become one of the largest producers of power steering for aircraft in the country.

"Producing Today ... Tomorrow's Aircraft Requirements" has resulted in many "firsts." An example is the design and development of electrical control for power steering, to replace all mechanical connections between pilot and nose wheel. Now the pilot has closer control than ever before obtained, with considerable savings in weight and initial cost, as well as installation and checkout time in the airplane.

"PRODUCING TODAY...TOMORROW'S AIRCRAFT REQUIREMENTS"

H. W. LOUD MACHINE WORKS, INC.

DEPT. 11

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Resident Sales Engineers located in
Seattle, Wash.
Kansas City (Independence), Mo.
Baltimore, Md.

85

EQUIPMENT

installation on the Douglas C-124

Reduce Air Frame Weight

as Grumman does on its New F9F-9

Use AEROQUIP 617 LIGHTWEIGHT AIR FRAME HOSE For Fuel And Oil Lines

The Navy's newest jet fighter, the Grumman F9F-9, is one of the world's few combat planes capable of supersonic speeds in level flight.

Important savings in weight were achieved by using Aeroquip 617 lightweight air frame hose instead of conventional types for fuel and oil lines.

Aeroquip 617 hose is recommended for use with lubricating oils made to specification MIL-L-7808 as well as petroleum products. Complete technical information is given in Aircraft Engineering Bulletin AEB-2 . . . please write for it.

A lighter wire braid imbedded in a thin, tough wall reduces hose weight without sacrificing performance.

Detachable, reusable aluminum fittings designed with extremely short socket provide further weight savings.

Aeroquip

REG. TRADE MARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN
AERO-COUPLING CORPORATION, BURBANK, CALIFORNIA
(A Subsidiary of Aeroquip Corporation)

Manufacturers of Aeroquip Flexible Hose Lines with detachable, reusable Fittings; Self-Sealing Couplings; Brazed Aluminum Elbows
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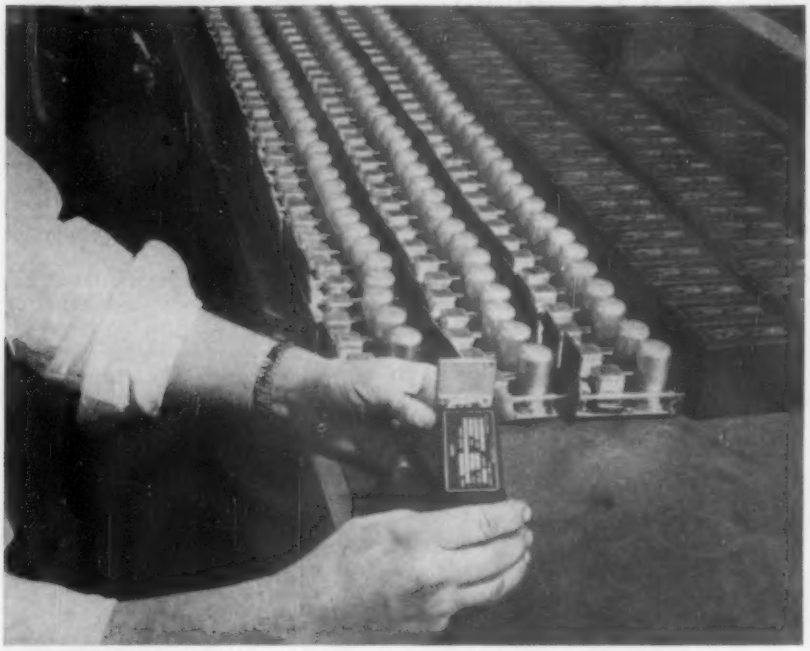


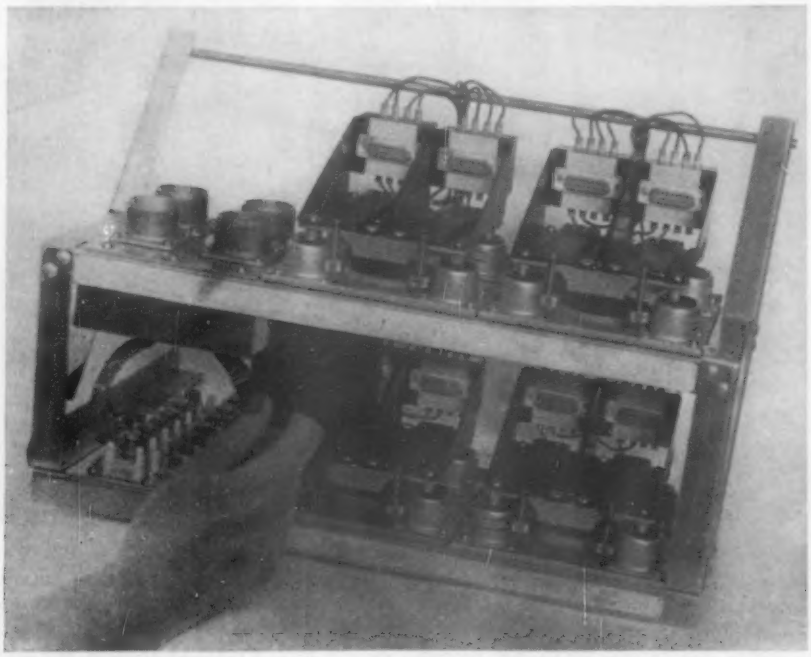
MINIATURIZED CONTROL BOXES are in mass production at Edison plant.

AF Buys New Temperature Alarm

A new overtemperature alarm system to monitor aircraft equipment susceptible of overheating has been put in production by Thomas A. Edison, Inc.'s Instrument Division.

Air Force has ordered close to a quarter of a million dollars' worth of the equipment for installation on Boeing B-50 Superfortresses where it will protect generators and alternators. Each aircraft will be equipped on a retrofit basis with eight complete systems—six for generators and two for alternators.

The system, developed in cooperation with Wright Air Development Center engineers, also is approved for installation on the Douglas C-124 Globemaster, according to Edison.



B-50 MOUNTING RACK for eight control boxes is tailored for fuselage-mounting.

▶ **Sensitive and Speedy**—The new alarm system is sensitive enough to detect minute temperature changes through the tip-sensitive temperature detector which is spring-loaded against the equipment to be protected. A metal strap holds the detector in place.

As soon as temperature limits are exceeded, the system gives an immediate alarm, visually, aurally, or both.

Other features:

• **Positive and accurate.** The system is practically immune to vibration, according to the company, therefore gives positive warning only when a real danger exists. Built-in accuracy is said to assure that it will operate only at predetermined temperatures.

• **Compact and reliable.** The single-circuit control boxes are the size of two king-size packs of cigarettes—3½x2⅞x 1⅝ in. Weight is 0.65 lb. alone or 0.8 lb. with cradle. In the B-50, eight boxes are mounted on a rack tailored to fit into a specific location in the plane's fuselage. Weight of the entire eight-system package in the B-50 comes to less than 20 lb., including all components and wiring.

Reliability has been achieved by having separate, independent circuits for each point being protected. The slight space sacrifice is relatively unimportant, says Edison.

▶ **System Components**—Edison's overtemperature alarm system uses standard Edison-designed and -manufactured electrical resistance temperature detectors as sensing elements. The overtemperature systems use tip-sensitive-type detectors. Stem-sensitive units are available to measure such elements as oil or air.

The control assembly, says Edison, is essentially a Wheatstone Bridge using a sensitive relay to detect the unbalance caused by an increase in resistance in the detector. A miniature slave relay carries the load necessary to operate a warning lamp and/or audible alarm in the flight compartment.

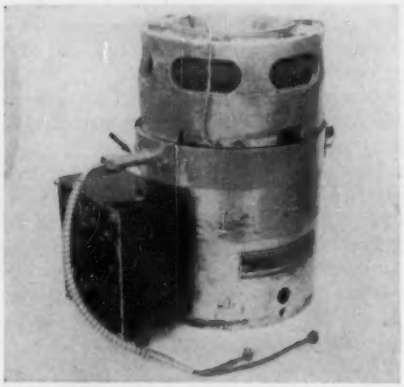
When the temperature reaches the alarm point, the bridge unbalances and the contacts of the sensitive relay close. At the same time, the slave relay operates and locks the circuit in the alarm condition until the reset button is actuated.

A test circuit permits remote testing of all components and wiring of the system.

▶ **Versatile Box**—Edison engineers say their control box's versatility allows single, basic control system to be used as a fire detection system or as a variety of overtemperature alarm and indicating systems.

The alarm systems can be designed with or without visual indication of actual temperatures being experienced

MINIATURIZATION techniques produce unit about the size of match box.



DETECTOR TIP (arrow) is mounted on special collar, protects a.c. generator.

at the source when the alarm point occurs. Also, a multiple-alarm system may use but a single visual indicator with a selector switch to connect it with any particular alarm system desired.

Still another advantage of the unit, says Edison, is that "its single-cell construction has the advantage of reducing to a minimum the time required to tailor the circuit to each new problem. Its simplicity makes it easy to put into production without extensive tooling, with little or no additional personnel training and with only minor changes in inspection procedures."

The device can provide automatic alarm on temperature rise, fall or on temperature differential spread.

Avianca Converting 30 DC-3s to Hi-Per

Avianca, Colombian airline, is converting 30 DC-3s to the Hi-Per configuration, replacing the transport's two 1,200-hp. Pratt & Whitney R1830 with 1,450-hp. P&W R2000s.

The conversion (AVIATION WEEK Nov. 1, 1954, p. 70) will increase the aircraft's speed by 34 mph., improve its rate of climb and single-engine ceiling.

Average total cost of Avianca's DC-3 fleet conversion, to be handled by Pan American World Airways' Latin American Division, will be $80,000 per plane. Engineering cost will be $7,500 each.

New Jet Ignition Uses High Frequency

A new high-frequency type of ignition system has been developed for gas turbines by the Plessey Co. in conjunction with D. Napier & Son, the patentees.

The system, which operates on the capacitor discharge principle, is said to offer these advantages:

- **High spark repetition rate** (50 per second).
- **Low initial firing delay** (less than 10 microseconds).

The system uses a conventional type of spark plug.

Plessey says that the insulated gap of the igniter plug is ionized by means of a high-frequency, high-voltage initiating surge, immediately followed by a low-voltage discharge of relatively large energy content. The high-frequency component helps to insure a discharge through fouled plugs.

In applications where large quantities of unburned fuel would accumulate in the combustion chamber if the repetition rate were low and the initial firing delay prolonged, the high rate and low delay of the new system would be advantageous. The system delivers its spark during the short period of favorable combustion conditions, so less energy is required by the ignition system.

Plessey is providing experimental units to gas turbine manufacturers for test to determine the best arrangements for effective ignition.

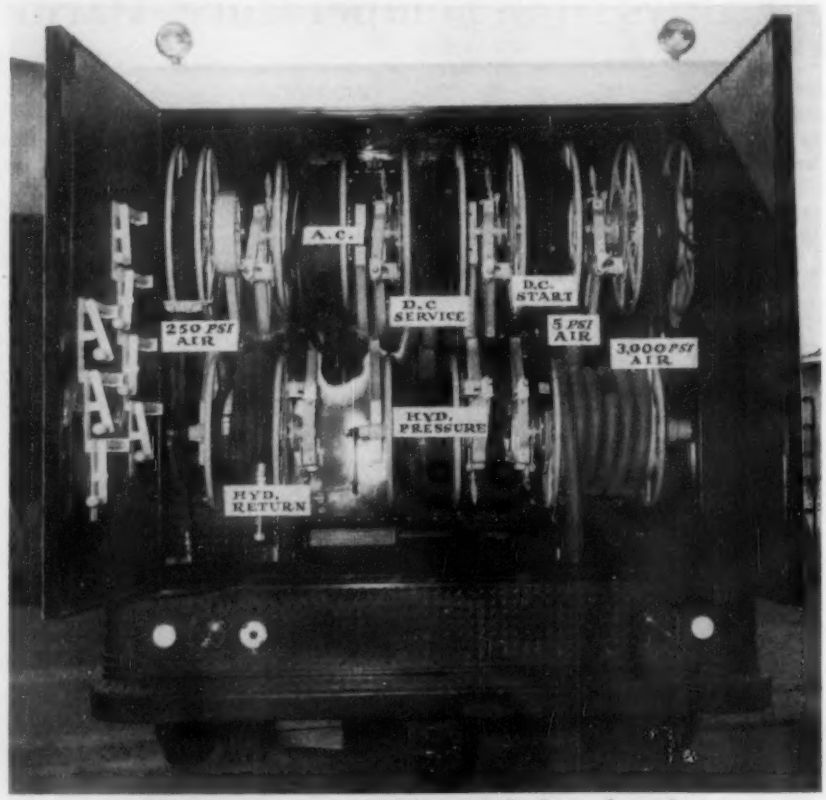
Afterburner Actuator Needs No Lubrication

Powered by air taken from a jet engine's compressor, a new stainless steel actuating cylinder and piston for afterburner nozzle control operates without need for lubrication, the manufacturer notes.

Installation requires no mounting bracket. The assembly connects through a $\frac{1}{4}$-in. hole in ball end and $\frac{33}{64}$-in. hole in cylinder end, providing flexibility at both terminals.

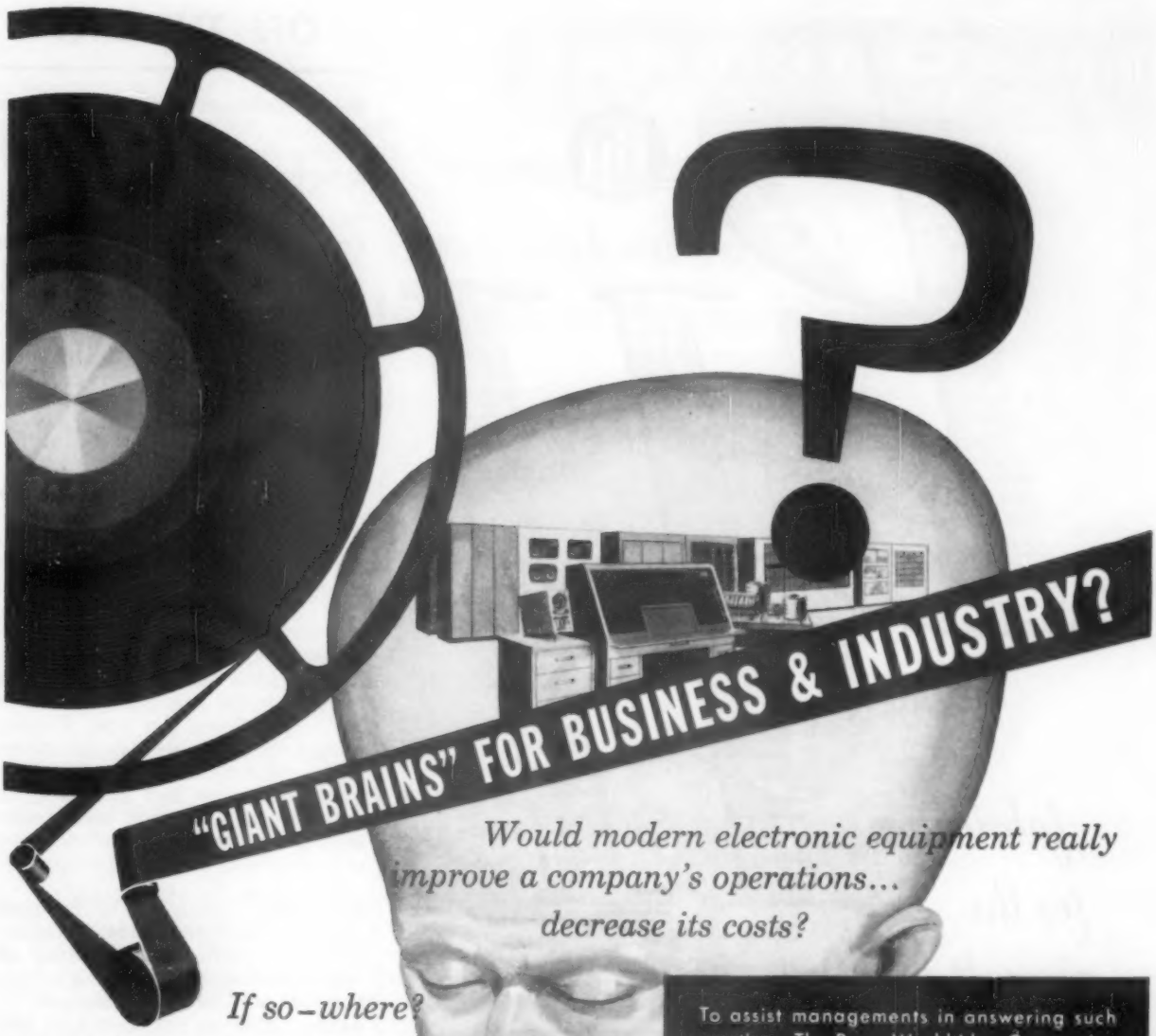
Weighing 2.875 lb., the Model RD-10400 has a piston area rated at 240 lb. force per 100 psi. applied air on the extension stroke and 220 lb. on the retraction stroke.

Lear-Romec Division, Lear, Inc., Elyria, Ohio.



Plane Servicer Planned for Arctic

Designed for advanced base and cold weather multi-purpose servicing of fighter aircraft, this vehicle, furnishing pneumatic, hydraulic and electric power, was recently demonstrated to USAF's Alaska and Northeast Air Commands at Longren Aircraft Co., Torrance, Calif. Servicer also carries special tools and can be used for towing. It is a joint venture of Longren and Aircraft Maintenance Systems, Inc.



"GIANT BRAINS" FOR BUSINESS & INDUSTRY?

Would modern electronic equipment really improve a company's operations... decrease its costs?

If so—where?

In production control? Payroll accounting? Customer billing? Factory automation?

What make of equipment is best? What changes in company methods and procedures would be required?

To assist managements in answering such questions, The Ramo-Wooldridge Corporation through its Computer Systems Division, offers to business and industry the consulting services of a team of scientists, engineers and business methods and procedure analysts experienced in the application of modern analytical and machine methods. With no equipment of their own to sell to non-military customers, but with understanding of available machines and techniques, this group is in a position to be objective in its recommendations.

Other activities of the Computer Systems Division include a program of development of an advanced type of digital computer for military applications and operation of the company's own computing center, consisting of extensive, general-purpose computing equipment.

These activities comprise a part of the program whereby The Ramo-Wooldridge Corporation seeks to maintain broad coverage of the important field of automation, computation and control.

The Ramo-Wooldridge Corporation

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OFF THE LINE

AiResearch Manufacturing Co. has been tapped to provide the complete cabin conditioning system for Boeing KC-135 jet tanker-transport series.

"Setting the Record Straight on the Pratt & Whitney R-1830-94" is title of 42-page illustrated booklet issued by Steward-Davis, Inc. The air agency says it assisted in obtaining the original certification to install this higher performance engine in Douglas DC-3 and Lockheed Lodestar aircraft in 1951. Copies are available to pilots and operators. Address: 13501 South Western, Gardena, Calif.

Rohr Aircraft Corp. pneumatic system joints for Boeing B-52 bleed air ducts permit leakage of only .0002% of total duct flow at operating temperatures and pressures. Units, being all-metal, have good high temperature characteristics and handle air with temperatures approaching 1,000F without trouble, according to the manufacturer. Pressures run close to 300 psig. The joints are of both the ball and slip type. Ducting using Rohr joints has a weight advantage over systems using thin-wall bellows to absorb motion and deflection, because the joints can carry basic tension loads inherent in the duct, allowing use of simple, lightweight duct supports.

First USAF planes to be equipped with a fire-resistant hydraulic fluid are Douglas C-118As. Planes coming off the production line are being factory-equipped with Monsanto Skydrol. C-118As already in service will be converted in the field to Skydrol.

UAL should finish fleetwide installation of Collins Radio 360-channel VHF receivers and transmitters in its nearly 200 aircraft by summer. The equipment, which replaces older units providing 50 channels, will cost United $1 million.

Two Off the Shelf

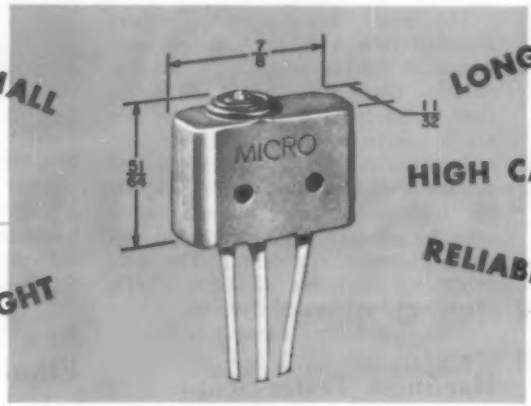
Airwork Corp. recently received an order for two R1830-75 engines (for a DC-3) on an exchange basis from Great Lakes Carbon Corp.

The Millville, N. J., engine overhaul agency did not have any -75 versions of the R1830, nor apparently did anybody else, and Great Lakes Carbon wanted fast delivery. So Airwork built up two complete engines from scratch, using only on-the-shelf spare parts—an unusual way for an overhaul agency to supply aircraft engines.

The entire job took 45 days.

MICRO SWITCH Precision Switches
A PRINCIPLE OF GOOD DESIGN

This switch has ALL you have asked for in a sealed subminiature switch!



Check these features against your most critical requirements

Absolutely environment-proof:
Switching element is sealed with an elastomer plunger seal. This is bonded to both the pin plunger and the metal housing. The switch element is embedded in an epoxy casting resin which also seals the leads. The exterior is of corrosion-resistant, treated aluminum.

Light weight—small size:
Unit is 7/8" long and 11/32" thick. Weight is less than .03 oz.

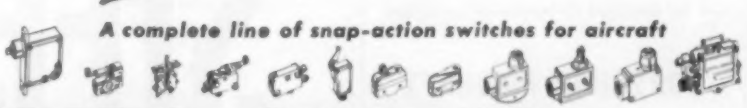
Wide temperature range:
Designed to give trouble-free operation in a temperature range of from —65° F to plus 180° F.

High electrical ratings:
Electrical rating is 30 volts d-c, 2.5 amperes inductive, 4 amperes resistive. Maximum inrush is 15 amperes.

Long life:
Minimum mechanical life, 300,000 operations under average use conditions.

There are always new switches and new assemblies on the drawing boards and on test at MICRO SWITCH. *Don't experiment. Call* MICRO SWITCH *first. It is the short cut to getting THE switch for your application.*

A complete line of snap-action switches for aircraft



MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

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METAL
CAA approved up to 165 hp

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up to 3000 hp

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Sensenich PROP SHOP . . . prompt propeller repair of all makes fixed pitch Wood. Sensenich, Hartzell, Beech Controllables, Metal or Wood; Sensenich and McCauley fixed pitch Metal. Magnaflux, etching, anodizing and plating service.

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★ New subsonic and supersonic projects are creating an urgent demand for aerodynamicists at Northrop Aircraft, Inc.: America's first company in the vital development, design and production of all-weather and pilotless aircraft.

★ If your training and experience qualifies you for one of these challenging assignments, please telephone or wire collect:

Mr. Robert Ehinger
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★ Expense-free Los Angeles interviews will be arranged for qualified applicants.

NORTHROP AIRCRAFT
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HAWTHORNE, CALIFORNIA

NEW AVIATION PRODUCTS

Lightplane Prop Line Features New Airfoil

A new line of fixed metal propellers for lightplanes up to 165 hp., featuring a departure from the commonly used RAF-6 airfoil, is in production. The new props are being supplied as factory installations on Piper PA-18s and PA-22s. Tests are currently being run to have the new unit approved for the Cessna 170.

The new 74-in.-dia. prop utilizes modified NACA Series 6 airfoils and somewhat thicker blades than previous models. Blade tip is wider and flatter than earlier types and the activity factor is approximately 5% higher, the maker reports. Basically, the new line was designed to absorb more efficiently the higher-horsepower engines being used by modern lightplanes and yet avoid excessive vibration. The propellers are fabricated of Alcoa 25ST6 aluminum heat-treated forgings.

Sensenich Corp., Lancaster, Pa.

Hardness Tester-Scope Is Combination Tool

Where the amount of hardness testing or microscopic measuring is not sufficient to warrant buying two separate instruments, a combination product is available.

Device consists of a Leitz micro hardness tester for checking small or thin parts, fine wires and the like, or surface layers of nitrated or case-hardened work. Indentation, visible at 400X magnification, is by means of a Vickers diamond. The indentation can be measured to 0.0005 mm. When used as a measuring microscope, the 100X magnification lens is used.

A special micrometer cross-slide stage has heavy-duty 1-in. micrometer drums graduated directly in 0.0001 in. without vernier, with total measuring range of 2 x 1¼ in. Gage blocks or other masters give additional capacity.

ONE INSTRUMENT does two jobs.

George Scherr Co., 200 Lafayette St., New York 12, N. Y.

New Voltage Regulator Eliminates Moving Parts

An all-static regulator, designed to provide precise voltage regulation for 400-cycle generating equipment and protect aircraft and electronic equipment from overloads, uses magnetic amplifiers, power current transformers and selenium rectifiers to lessen maintenance and provide more efficient operation, the maker states. Usable for direct excitation of the a.c. machine, the unit, designated RX400, eliminates the need for a rotating d.c. exciter. It can be regulated to ±½%.

Inet Division, Leach Corp., 4441 Santa Fe Ave., Los Angeles 54, Calif.

Remote Recorder Monitors Wide Range of Tasks

A simply installed 30-channel recorder gives instantaneous, permanent

STEEL **in stock**
CERTIFIED QUALITY...
QUICK DELIVERY
PRODUCTS: Carbon, Alloy & Stainless Steel Bars, Structurals, Plates, Sheets, Tubing Reinforcing, Babbitt, Machinery & Tools, etc.
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KOLLSMAN
PRESSURE RATIO
THRUSTMETER
used on
Convair's F-102
McDonnell's F-101

which way* to measure jet engine performance?

THRUSTMETERS

to indicate PRESSURE RATIO
to indicate DIFFERENTIAL PRESSURE

TYPICAL SYSTEM OPERATIONAL DATA

1. Accuracy: .015 in 100% of readings at room temperature.
   .025 in 85% of readings at −55°C and +70°C.
   .035 in 15% of readings at −55°C and +70°C.
2. Altitude: No specific limitation.
3. Power: 115V, 400CPS, single phase, 18VA
4. Pressure Ratio Range: 1.2 to 3.4
5. Pressure Ranges (operating):
   Pt_2=2 to 50" Hg. Abs.
   Pt_7=2.4 to 100" Hg. Abs.
   Pt_7-Pt_2=0.4 to 70" Hg.
6. Temperature Range: −55°C to +70°C.
7. Weights:
   Transmitter: 2.2 lbs.
   Indicator (including integral amplifier): 1.8 lb.
8. Response: Full Range in 7 seconds.

Actual photograph

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on components for BOTH TYPES — for Remote or Direct reading

For over a quarter century, Kollsman has been making precision pressure sensitive mechanisms using displacement type diaphragms. This diaphragm can be called the heart of a thrustmeter pressure indicating system.

Our long experience making displacement type diaphragms guarantees reliable thrustmeters.

Proven Kollsman displacement type diaphragms, when fitted with Kollsman Synchrotels, comprise the transmitters for remote indicating types. Thousands of Synchrotels are now in use in other applications equally demanding of accuracy and durability.

Tailor-made Thrustmeters can be supplied for any engine-airplane combination. Write for complete technical information.

**The Pressure Ratio System has advantages for indicating optimum climb and cruise throttle setting, whereas the Pressure Differential System has a definite advantage at take-off.*

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AIRPOWER

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22nd Annual Aviation Week

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will cover vital aviation subjects on global scale

AVIATION WEEK'S 22nd ANNUAL "INVENTORY OF AIRPOWER" EDITION—"Airpower in the Age of Peril"—covering every phase of U.S. civil and military aviation, and providing the latest information on foreign airpower, will be published March 14, 1955. Featuring the complete story of the transition from the Korean crisis buildup to the solid industrial and airpower base necessary to meet the requirements of U.S. Policy over the long pull, this important issue will hold significant and lasting interest throughout the aviation world.

Aviation management men, engineers, military and government officials will read, refer to and depend upon "Airpower in the Age of Peril." Only in this edition will be found full information on fiscal 1956 federal aviation budgets, new procurement and financing regulations . . . ground rules that will guide Air Force and Navy policy in doing business with the aviation industry over the next two years, as well as latest reports from AVIATION WEEK correspondents in every part of the world on significant developments abroad.

Reference tables especially designed for "Airpower in the Age of Peril" will give new, revised specifications on U.S. and foreign aircraft, missiles, and engines. Special reports will cover the expansion of the guided missiles industry, the conversion of domestic and international airlines from piston to gas turbine powered equipment (including full statistical coverage of all U.S. and foreign airline operations), the expanding role of equipment and component manufacturers in the weapons system development and production cycle, and avionics in military and civil aviation. This storehouse of vitally needed aviation information will be used constantly wherever aviation business is transacted.

This extremely great usefulness to the aviation industry gives "Airpower in the Age of Peril" prime importance as an advertising medium. Aviation companies and their suppliers will find the long-lasting selling power of this significant AVIATION WEEK issue unmatched in aviation publishing today.

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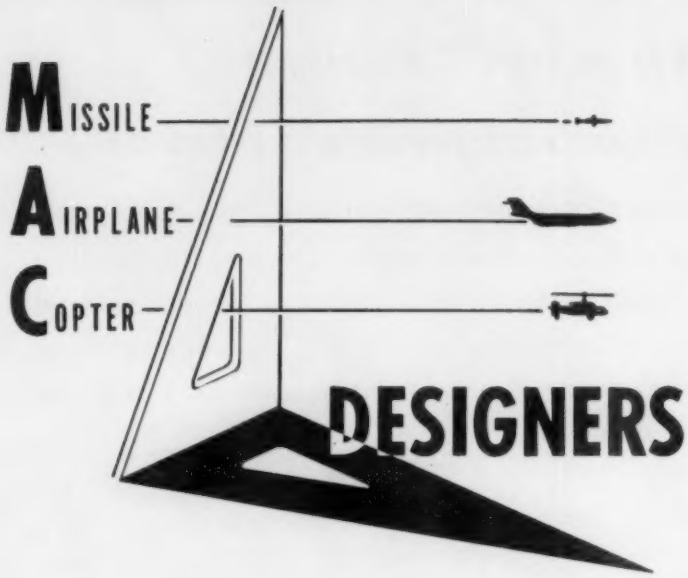

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DEVICE WATCHES up to 30 machines.

record of operation, cycle, down-time of up to 30 production machines or other activities.

The device utilizes electrosensitive paper, upon which tiny styli record activity passed along by electric current. Record is smudgeproof, the maker notes. Attachment is by means of simple switches readily connected to the machine or other activity to be monitored. A line runs from the switch to the recorder. The device requires no skills to set it up, operate or maintain, the firm states.

Two models are available: Type 230A-6 with tape speeds of 1 and 6 in. per minute and Type 230A-12 with speeds of 1 and 12 in. per minute.

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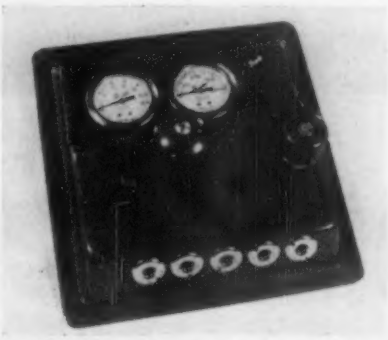
Light Oxygen Console Fits Business Planes

Business aircraft owners are offered a new oxygen console weighing only 3 lb. with five mask outlets, for about $300.

Mountable anywhere in the cabin, it can be attached by two quick-disconnect brackets to the oxygen cylinder, which may be placed in the baggage compartment. To operate the console, it is set at cruising altitude and as many masks as needed are plugged in. Each outlet



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Actual unretouched photo of scarred but unharmed Rate Gyros

-two American Gyro, floated rate-gyros, model # CLASSIFIED serial numbers CLASSIFIED and CLASSIFIED, proved their complete reliability and amazing ruggedness by remaining satisfactorily operative after recovery (linearity remained CLASSIFIED resolution remained CLASSIFIED).

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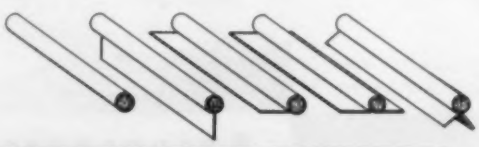
Write for engineering data and information.



ARROWHEAD RUBBER COMPANY
Division of National Motor Bearing Company, Inc.

2343 CURRY STREET, LONG BEACH, CALIFORNIA

is an on-off valve. Disposable masks are 85 cents each.

Scott Aviation Corp., 275-P Erie, Lancaster, N. Y.

Identification Camera Gives Badge Prints in Minutes

Utilizing the Polaroid "print-a-minute" principle, a new identification camera rig can be operated without need for a darkroom or experienced operators. Up to 110 employes per hour can be photographed, the maker states.

Camera package includes a mounting and lighting system and a positioning bar for accurate focus. Designated Model F-301, the equipment is portable and can be set up quickly, permitting photographs to be made for visitors' badges, if desired. Two identical prints are made with each exposure, four photos per piece of Polaroid film.

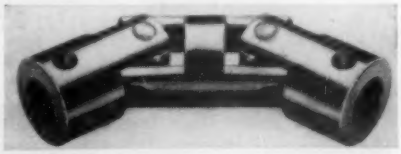
Fairchild Camera & Instrument Corp., Syosset, N. Y.

ALSO ON THE MARKET

Aircraft hinges H84 and H85 make possible fastening doors without necessitating skin cutout in airframe, manufacturer says. Hinges require only .450 in. maximum depth dimension below the skin surface and can be fastened to door and structure with rivets or spot welding. Available with or without spring loading and in lengths of two inches to six inches in increments of one inch.—Hartwell Aviation Supply Co., 9035 Venice Blvd., Los Angeles 34, Calif.

Large bore bearings of thin section are finding application in helicopter and jet engine gear boxes, accessory drives and machine tools.—Fafnir Bearing Co., New Britain, Conn.

Inexpensive universal joints in two variations are intended for application where flexible shafting is inadequate. Dual-type universal joint allows lateral and angular displacement between connecting shafts, and operates with included angles of 90 deg. or more; other unit comprises a universal couple re-



sembling a universal joint except that the block floats within the forks without pivot pins, allowing for moderate angular misalignment when connected to stably supported shafts.—Kupfrian Manufacturing Corp., 381 State St., Binghamton, N. Y.

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- 21 INSPECTORS to each 100 production workers—a 1 to 5 ratio.
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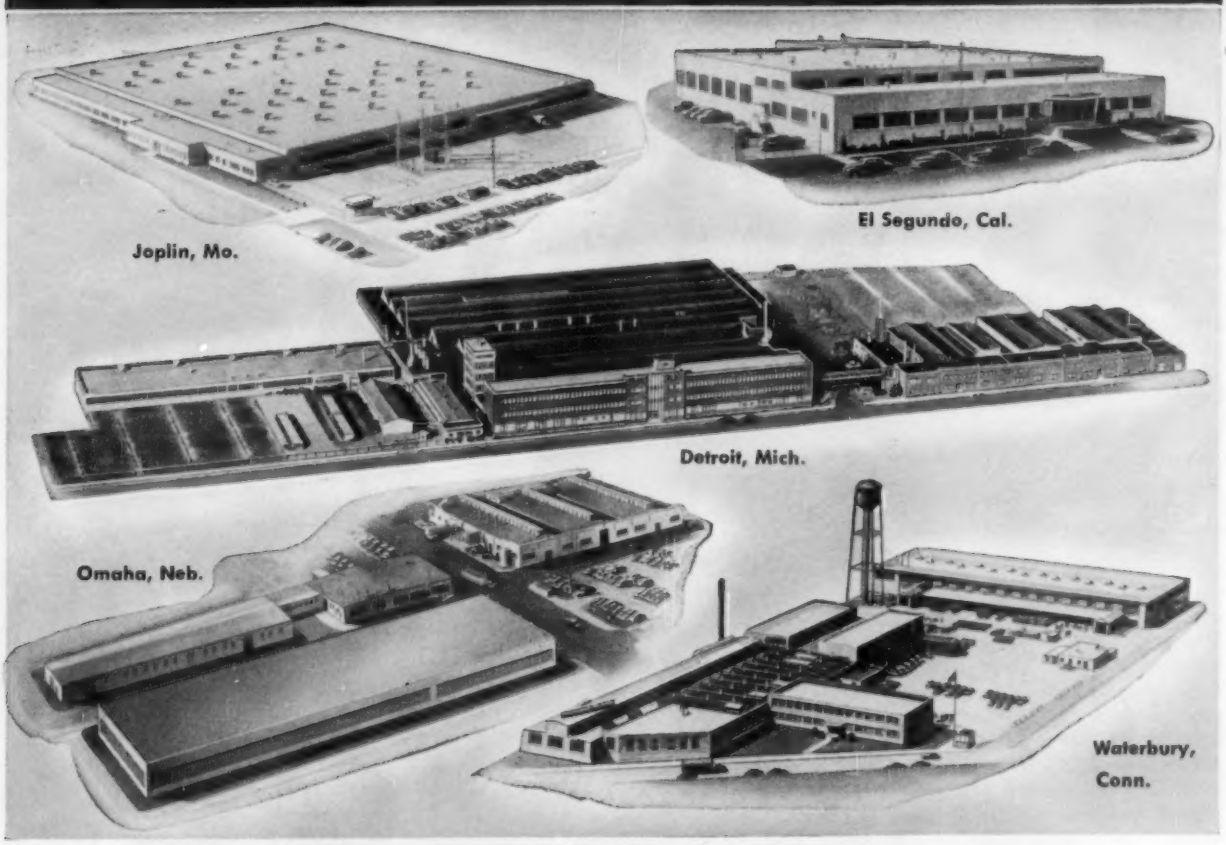

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FINANCIAL

BEECH
50% stock dividend was made in January 1949.

BELL
2-for-1 stock split was effected in February 1952.

BOEING
50% stock dividend in May 1952 was followed by a 2-for-1 stock split in May 1954.

DOUGLAS
3-for-2 stock split in March to holders of record Feb. 2 follows 2-for-1 stock splits in May 1951 and May 1954

GENERAL DYNAMICS
100% stock dividend will be paid Mar. 10 to holders of record Feb. 23.

GRUMMAN
2-for-1 stock split of November 1950 followed the 2-for-1 stock split in June 1948.

LOCKHEED
2-for-1 stock split effected in July 1951. Also, 10% stock dividends were paid in January 1953 and again in January 1954.

MARTIN
10% stock dividend was paid in December 1954.

NORTHROP
10% stock dividends were paid in December 1953 and 1952.

REPUBLIC
10% stock dividends have been paid in December 1954, 1953, and 1952.

UNITED AIRCRAFT
20% stock dividend was paid in May 1, 1951 (also, Chance Vought was "spun-off" as of Dec. 31, 1953).

Aviation Week compilation.

Stock Splits Mark Strong Market

The recent stock split and increased cash dividends voted by Douglas Aircraft Co. provide another manifestation of the high degree of prosperity currently being experienced by the aircraft builders (AW Jan. 31, p. 7).

Douglas will effect a 3-for-2 split to stockholders of record Feb. 2 the first week in March. In addition, a quarterly cash dividend of 75 cents per share and an extra of 75 cents will be paid on Feb. 23. Prior to this action, the company paid three quarterly dividends of 62.5 cents plus two extras of 87.5 cents and one of $1.625.

At present, Douglas has 2,459,860 shares outstanding. In May 1954, the company split its stock on a 2-for-1 basis. This followed a previous 2-for-1 split effected in May 1951. As a result of the up-coming split, there will be a total of 3,689,790 shares outstanding. Contrast this with only 600,000 shares prior to May 1951.

▶**Paper or Profit?**—Theoretically, stock splits do not create any new values, in themselves, or give the stockholder anything new which he did not previously

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produces fire bombs efficiently

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TRANSISTOR & DIGITAL COMPUTER TECHNIQUES

applied to the design, development and application of

AUTOMATIC RADAR DATA PROCESSING, TRANSMISSION AND CORRELATION IN LARGE GROUND NETWORKS

ENGINEERS & PHYSICISTS

Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of large ground radar weapons control systems.

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or with exceptional ability, are invited to consider joining us.

fields include

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VERY HIGH POWER MODULATORS AND TRANSMITTERS

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Culver City, Los Angeles County, California

Relocation of applicant must not cause disruption of an urgent military project.

Engineered for fool-proof maintenance . . . Edison's continuous cable fire detection system

Now a solid coaxial cable linked to a control assembly designed without electronic tubes or complex mechanisms assures maintenance-free service with least amount of personnel training. Low impedance operation eliminates possibility of false alarms due to moisture or capacitive effects in the new EDISON aircraft fire detection system.

Another important development from the world-famous EDISON Laboratory that increases the reliability of this system is its ability to signal fire even with a break in the sensing cable.

Check these other outstanding features, too:

- **direct operation** – from 28 volts d.c. without amplifiers of any kind.
- **rapid response** – signals "Fire Out" automatically; responds repeatedly to fire exposure.
- **extreme flexibility** – permits installation in irregular and inaccessible spaces.
- **maximum versatility** – a single detector circuit may have varying temperature alarm points.
- **simple to install, easy to maintain**–exclusive spring clamps reduce cable installation to seconds, and there are no brittle parts to fracture in the easily flexed cable.

Here is the finest fire detection system . . . especially designed for today's high-speed, high-performance aircraft. *Write today for complete details.*

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possess. A 2-for-1 stock split, for example, merely gives a shareholder two pieces of paper in place of one representing the same equity.

As a practical matter, however, stock splits generally are most welcome and invariably warm the hearts of stockholders. These splits are harbingers of rising earnings. They frequently result when market quotations reach high price levels. By increasing the number of shares outstanding, they tend to broaden marketability. They narrow the spread in quotations, facilitating the purchase and sale of the stock. In the process, market stability and quality improvement is engendered. Further, the number of stockholders is also increased, thus uncovering new support for possible financing.

There can be no doubt that an early Douglas stockholder has done remarkably well as he collected the repeated "pieces of paper" through stock-splits, plus liberal cash dividends. For example, in late 1950 it would have been possible to have bought 100 shares of the old Douglas stock (before any splits) for around $7,500. These 100 shares have now grown to 400 shares (and will soon be 600), and command a current market quotation of more than $56,000. In addition, during this four-year period, total cash dividends of $4,352 have been received.

▶ **Stock Dividends Too**—Separate and distinct from stock splits are stock dividends. Stock dividends are paid either to supplement or in lieu of cash dividends.

Qualified by the position and earnings trend of the company involved, stock dividends are generally greeted as favorable by stockholders, but not always. For practical purposes, a stock dividend permits the company to retain cash in the enterprise while appearing to give the stockholder a form of return. There can be no doubt, however, that stock dividends tend to convert earnings into permanent capital and require management to earn a return on the reconverted capital. Further, stock dividends serve to reduce income taxes for the recipient by translating regular income to capital gains.

If the enterprise is profitable and further expansion and growth is indicated, upon which additional earnings are to be created, the stockholder may be better off to receive stock and have equity values augmented.

The aircraft industry, experiencing a dynamic growth pattern has resorted to both stock splits and stock dividends—all with good results.

In the instances cited in the table at the head of this story the recipients have profited handsomely. This is a tangible reflection of the strong upward earnings trend of the aircraft builders in recent years. —Selig Altschul

Freedom's Team

At outposts of freedom near the Arctic Circle—made possible by our agreements with other governments which stand with us against aggression—U.S. Air Force men are now standing around-the-clock, around-the-calendar guard. Backing them up are the resources of American science and industry which have produced the Northrop Scorpion F-89 all-weather interceptor. The F-89 is America's heaviest-armed fighter. Wing-tip "hornet's nests" which carry 104 rocket projectiles are coupled with the latest electronics to make the F-89 a deadly aerial destroyer, capable of striking a bomber 45,000 feet and more above the earth. These jet home defenders are one of many modern weapons created by the engineering and production complex of Northrop Aircraft, Inc., since 1939 America's first company in the vital design, development and production of all-weather and pilotless aircraft.

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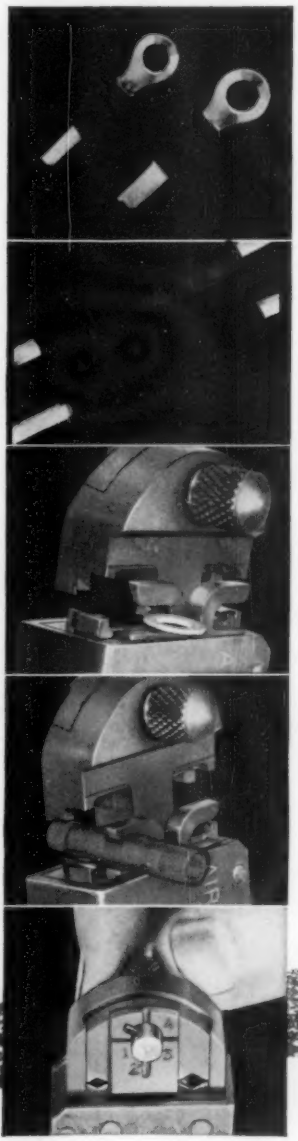

Here's the one hand tool that works on 80% of all aircraft wiring. AMP's new T-Head Tool crimps terminals and connectors in both 22-18 and 16-14 wire size ranges. Crimping jaws are color coded to match AMP color coded terminals and connectors and each crimp is branded with AMP's Proof-mark of Quality.

A special take-up device holds wire firmly for one handed operation of the tool. Then AMP's Certi-crimp ratchet takes over and prevents the tool from being opened until the crimp is completed. The tool is adjustable for all aircraft wire insulation thicknesses and is balanced for less operator fatigue regardless of the size of the operator's hands.

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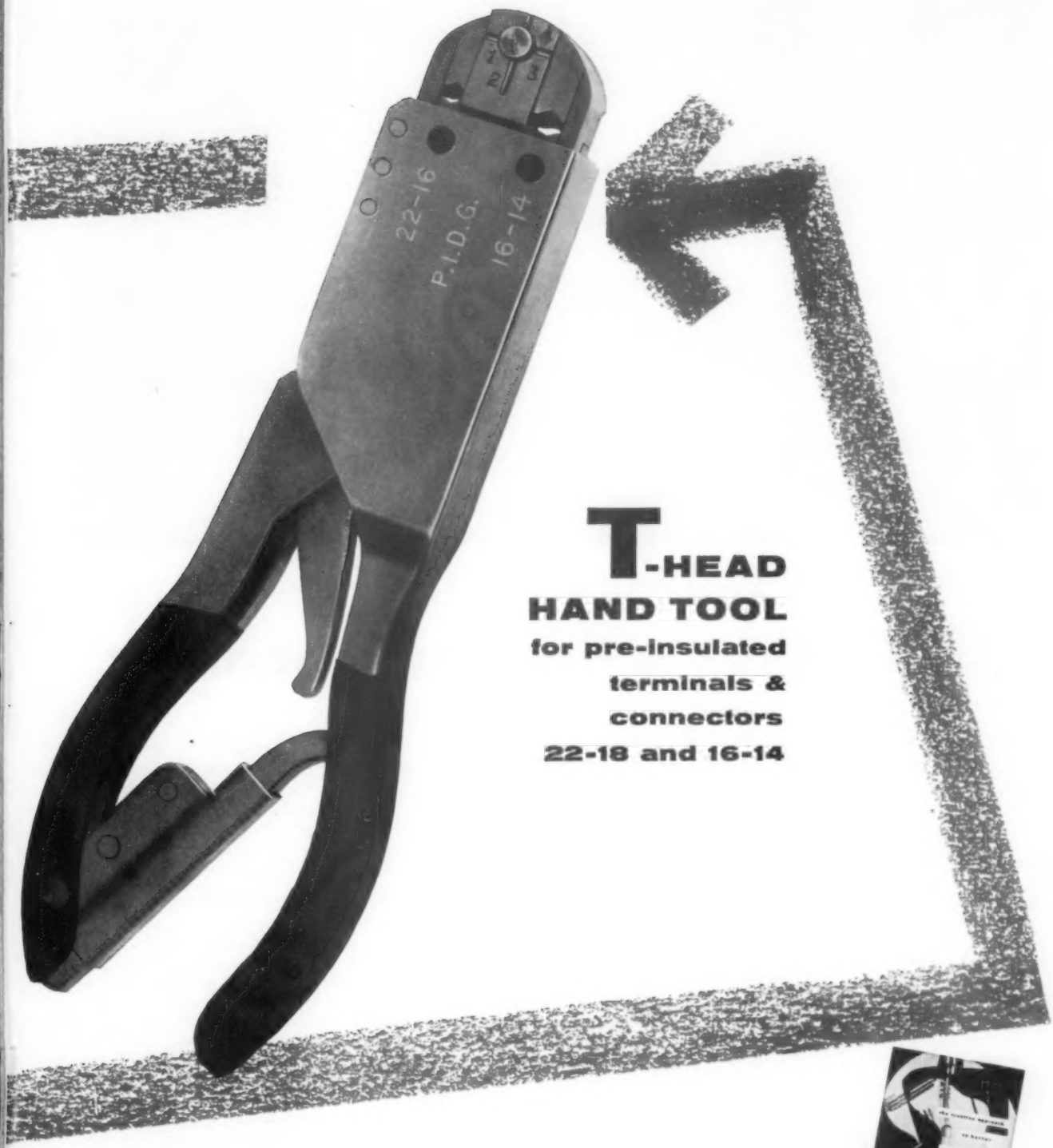
Another example of AMP's Creative Approach to Better Wiring



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U.S. Navy's A4D Skyhawk

U. S. Navy's one man bomber

The Skyhawk, *less than half the size of many current operational jet fighters*, is a revolutionary type of attack plane for the Navy. It's a "Mighty Midget" . . . capable of carrying atom bombs.

Powered by a Wright J65 Sapphire turbojet engine, the tiny Skyhawk can operate from carriers of all sizes. And its simplified lightweight design gives it a combat radius greater than many present propeller-driven attack planes.

Of its design, Edward H. Heinemann says, "We tried to integrate into the A4D the doctrine that by better engineering, airplanes can be built smaller and more efficient, as well as at considerably less cost and in shorter time."

Mr. Heinemann is chief engineer at the Douglas Aircraft Company's El Segundo, California, Division, where the Skyhawk is now in production.

In keeping with his philosophy of engineering, Inco Nickel and Inco Nickel Alloys are used in many parts essential to efficient and successful operation of the Skyhawk . . . used especially in *parts where strength and corrosion resistance at high temperatures are needed.*

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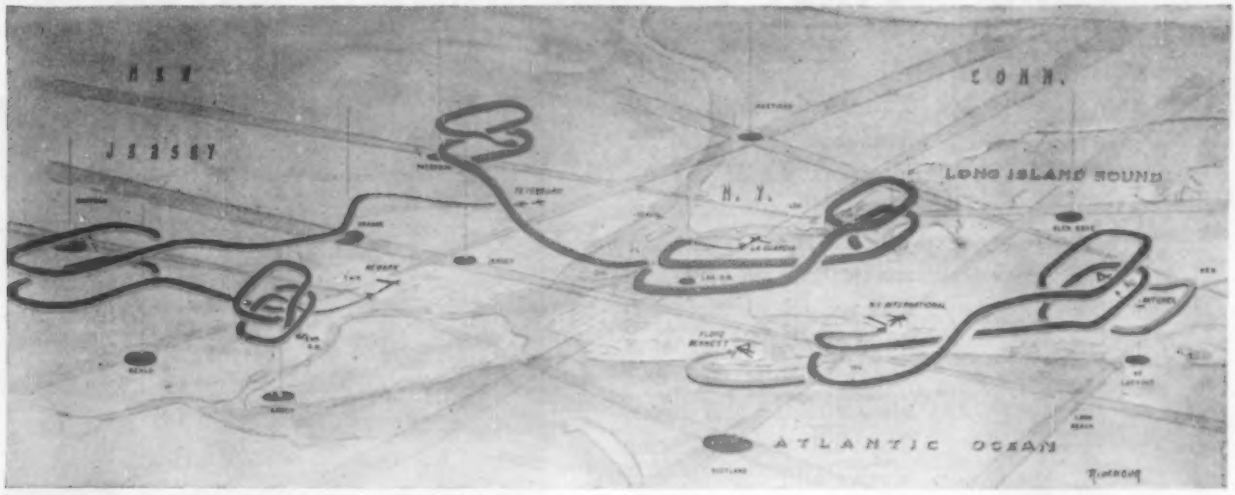

FIVE APPROACH GATES to airports in the New York area are shown in this artist's sketch of the new longrange radar control system.

New 'eyes' for New York controllers . . .

Air Route Radar to Tackle Traffic Snarl

By Gordon Conley

Longrange radar will get its stiffest test in air traffic control next month. It will be set up in Greater New York to control the aircraft traffic flow of six airports within a 17-mile radius of LaGuardia.

If air route radar can clear up congestion in this restricted and complex area, it will be able to handle air traffic flow anywhere in the United States.

The new installation will be a second step toward a radar network that eventually will cover all U.S. airways, following the longrange system now operating successfully in Washington, D. C. (AVIATION WEEK Mar. 16, 1953, p. 14).

New York's radar will have a range of 100 miles and channel aircraft into the area through five feed points, compared with a 40-mile range and two approach gates at Washington.

▶ **Workable Tool**—The longrange radar set up at New York is not a device specially developed for air routes. The basic unit is a military system built for U.S. Air Force. It is coupled to horizontal plotting boards designed late in World War II for Navy battleships and modified by Civil Aeronautics Administration.

Display scopes will show only azimuth and distance of aircraft. The Air Route Traffic Control Center still will depend on flight progress and pilot reports for altitudes.

But it is the best workable tool now available and will give ARTC controllers a visual check of aircraft within a radius estimated at more than 100 miles.

A temporary installation at Mitchel Air Force Base on Long Island will give this radar model its first practical application to en route air traffic control soon after equipment tests and tuneups are completed Mar. 1.

New York Operation

The operation was tried on paper in 1953 at CAA's Technical Development and Evaluation Center in Indianapolis. Tests fed actual flight arrivals and departures within the New York area into a dynamic air traffic control simulator.

Results of the evaluation showed New York's acceptance rate under instrument flight rules (IFR) could be increased substantially by tying longrange radar into surveillance and precision approach gear.

▶ **2,500-Plane Peaks**—Immediate goal of CAA controllers in New York is to handle more efficiently the area's present traffic volume that reaches peaks of approximately 2,500 aircraft within a 24-hour period. The controllers also want to gain enough experience with the new system to take care of projected increases in the future.

Purposes of the radar operation:

• **No landing delays.** One of the major bottlenecks is caused by the high altitudes of planes as they enter the approach control area. With radar, CAA controllers will be able to bring aircraft off the airways to low entry altitudes and clear first arrivals for first landings.

The ideal flow of arrivals under saturation conditions will have the first aircraft touching down as the second plane enters on final approach and the third follows just outboard of the gate fix (outer marker).

• **Increased takeoffs.** Under the present system, outbound aircraft often are delayed until preceding planes diverge onto different routes and altitudes. With radar, controllers will be able to flush out a larger number of aircraft in a given time.

The longrange gear will follow departing craft after they leave surveillance scopes and control the transition from a minimum area interval of three miles to the 10-minute airways separation.

• **Positive control of lost aircraft.** All landings and takeoffs now are halted until a pilot lost in instrument weather is brought in. Radar could fix the unidentified stray's position and vector other aircraft around it.

▶ **Two-Way Operation**—Operation of the new Radar Air Route Traffic Control Center will work on a two-way principle: Longrange radar will feed inbound aircraft to airport surveillance units, and the shortrange gear will channel outbound traffic to RARTC airways scopes.

The new system will start operating soon after Mar. 1 at Mitchel AFB and move late this year to a new area control center now being built by the Port of New York Authority at LaGuardia.

For arrivals, the operation will set up this approach control for feeding air-

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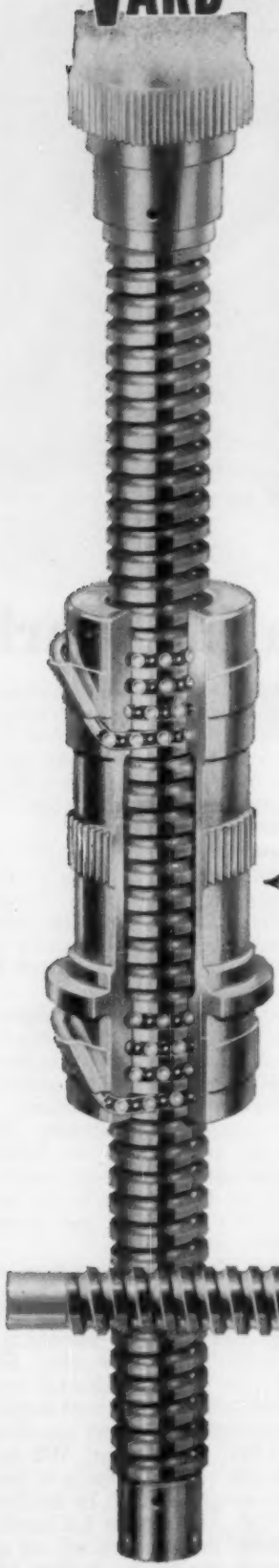
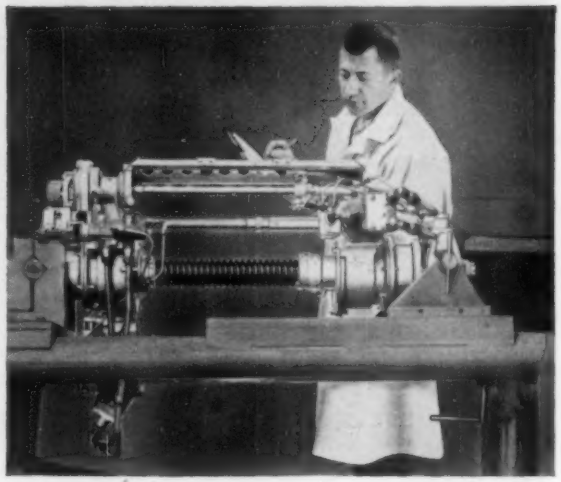


This complete Boeing B-52 Stabilizer Trim Actuator incorporates a 2.87" P. D. Vard ball nut and screw which is made from 9315 steel carburized to Rc 58 and utilizes multiple circuits of alternate spacer and load balls. The unit also contains 3 gear drives, 2 hydraulic motors, 2 Acme screws and electric and hydraulic actuators.



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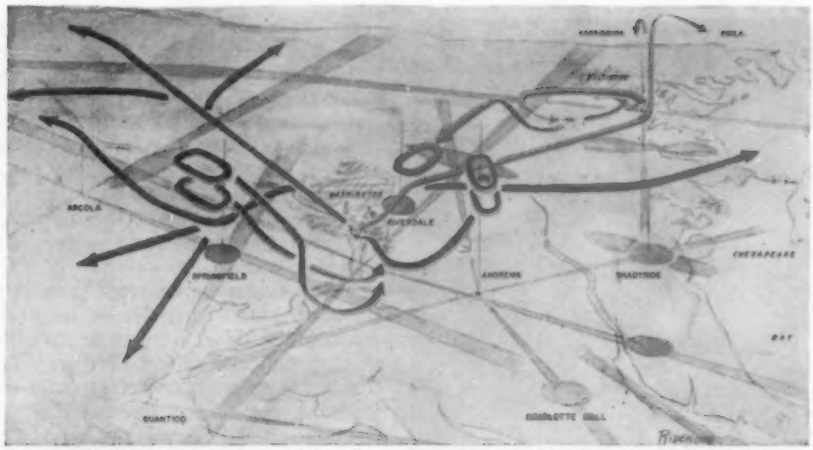


TWO FEEDER POINTS are used by the radar system at Washington National Airport.

planes into the three major and three minor airports in the New York area:

• **LaGuardia** will have dual approach fixes, one west of Jersey City where the northeast course of Newark's low-frequency range intersects the northwest course of Idlewild's LF range. The second will be over Idlewild's low-frequency range.

• **Newark** also will have two feed points, one at Amboy on the south shore of Staten Island and the other over Menlo Park, N. J. Inbound traffic for Teterboro (N.J.) Airport will be funneled through these fixes.

• **Idlewild International** will have only one approach fix, located at Point Lookout on Fire Island. From this single gateway, Idlewild will feed traffic to its own runways, to Mitchel AFB and to the Naval Air Station and Air National Guard Base at Floyd Bennett.

The Idlewild approach also will channel Long Island air traffic to Grumman Aircraft Engineering Corp. at Bethpage, Republic Aviation Corp. at Farmingdale and Zahn's Airport, a private field in Babylon Township.

For departures, the new system will be somewhat the reverse of approach controls. Surveillance radar will watch the aircraft until they pass the outbound fixes and reach cruise altitudes. The longrange unit will take over on the airways, monitoring separation limits until the planes reach the 100-mile radius limit.

▶ **'Over Optimism'**—Some air traffic control experts in New York are concerned with widespread "over optimism" that the new radar installation will be the answer to all traffic problems in the area.

"We know little about this radar," they say. "But what we do know indicates many limitations. Identification of individual aircraft on the display scopes may become a major problem. And we do not believe coverage will be complete. Snow and rain will be able to clutter the scopes. The airways will not be monitored at low altitudes."

The ATC experts also point to the human engineering problem. Radar will be a new and strange tool for personnel in New York's Air Route Traffic Control Center. During the transition stage, it will add to the strain and pressure of carrying the responsibility for one of the heaviest and most complicated air traffic loads in the United States.

Washington Operation

Most airline pilots, especially those who fly into Washington, D.C., do not share this cautious attitude. They say the longrange radar has been a "tremendous help" at Washington since the installation started to operate in 1953.

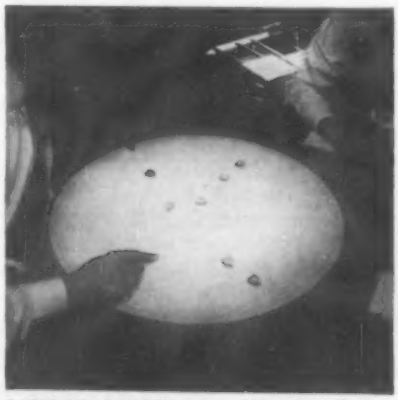
"There's no doubt about it" they say, "it does speed up landing approaches and takeoffs. Sometimes we can't descend as fast as they call us in.

"On airways, the Washington center can tell right away if two planes are converging courses. And it can tell pilots where to go to avoid turbulence and heavy precipitation areas."

▶ **40-Mile Radius**—In principle, the longrange radar system in New York will be similar to Washington's operation. The major differences include: The USAF radar at Washington has a radius of only 40 miles; it serves only one major commercial airport—Washington National.

Aircraft are fed into the national capital through dual approach fixes, one at Springfield and the other at Andrews. From these two points, planes are vectored around to the final approach course and over the runway gate.

The radar unit is an Air Force microwave early warning system developed in World War II.



DISPLAY SCOPE covers 100-mi. radius.

EAL Goal: 5 Billion Seat-Miles by 1956

Eastern Air Lines plans to increase its total airlift capacity from 3.5 billion seat-miles to 5 billion by the end of 1956. To build up its fleet for this job, EAL last week ordered eight more Douglas DC-7Bs—bringing to 20 the total to be delivered within the next two years.

The orders brought Eastern's total contracts for DC-7Bs to $40 million and will increase its investment in new equipment since 1952 to $180 million.

Capt. Eddie Rickenbacker, chairman of the airline's board, said the new transports will require no additional financing. They will be paid for out of profits, depreciation reserves and proceeds from an existing bank loan.

▶ **Aircoach Expansion**—At a press conference in New York's 21 Club, Rickenbacker said the fleet buildup is part of Eastern's program to expand aircoach services and to put its first-class schedules in a speed range between 350 and 400 mph.

He reported the first stage of Eastern's expansion program resulted last year in a traffic increase of 23%, nearly double the air transport industry's average gain of 12% (AVIATION WEEK Jan. 3, p. 71).

Aircoach made the biggest jump, accounting for more than 51% of the total traffic. It is expected to reach 60% by the end of this year.

"The key to our expansion program is aircoach," Capt. Rickenbacker said. "By the end of 1956, 70% of our flights should be coach. This is the growth area. If we build up aircoach, more first-class traffic will develop automatically."

▶ **First-Class DC-7Bs**—Eastern's new DC-7Bs will be put on first-class flights as they are delivered. First of the $2-million transports is scheduled to arrive in EAL's hangars next June, with others following on a one-a-month basis.

As the DC-7Bs are put into service, Lockheed Super Constellations now used for first-class service will be converted to aircoach configurations. The coach fleet is expected to total 48 four-engine transports by the end of 1956.

Rickenbacker indicated the DC-7Bs are the last piston-engine transports

EAL will buy. He predicted turboprop-powered airliners would be operating by 1958 and turbojet aircraft by 1960.

"But there are no turboprops or jets now that we can use," Eastern's board chairman said. "For our work, the Vickers Viscount does not have enough speed, range or payload. In jets, we are watching the Boeing 707, Douglas DC-8 and the Lockheed."

▶**Airfreight Factor**—Rickenbacker said the one important factor not computed in EAL's projected growth is airfreight, although this is given high priority in the airline's planning.

"Over the past several years, our engineers have been working with manufacturers looking toward development of a large, economical airfreighter," he said. "To give shippers a service they can afford to buy, we need a transport that will get freight costs down to five or six cents a ton-mile.

"Until now, however, the reluctance of the aircraft manufacturers to pioneer and the inability of the commercial (air transport) industry to finance the development of an airfreight have blocked progress in this direction."

CAB Nominee Gets Democratic Support

Early Senate confirmation of the nomination of Ross Rizley, 62, former Republican congressman from Oklahoma, to a six-year term as a member of Civil Aeronautics Board appears likely.

Democratic Sen. Mike Monroney, also of Oklahoma and the chairman of the Senate Commerce Committee's aviation subcommittee, told AVIATION WEEK he approved the Republican appointment, and did not anticipate opposition to it. Monroney said he considers Rizley a "neutral" selection without firm convictions on the controversial issues to be solved by the Board.

▶**White House Choice**—Rizley frankly volunteered that he has no aviation background "aside from riding planes" and that he did not seek the CAB appointment. "I was asked by the White House staff to take it," he commented.

Rizley's only indication as to what his attitude might be as a Board member: "I want the public to get a square deal."

However, as solicitor of the Post Office Department for a brief period, from March to December 1953, Rizley participated in Post Office's efforts to separate airmail pay from subsidy, have the so-called "off-set principle" apply to airmail earnings, and reduce service mail payments.

▶**Agriculture Post**—Rizley served in the House from 1941 to 1949, six years as a member of the Agriculture Committee and later as a member of the Rules Committee. Previously, he practiced law in Oklahoma, and held numerous state elective offices. After leaving Post Office, Rizley, until recently, was an Assistant Secretary of Agriculture.

RIZLEY: Give the public a square deal.

Rizley, if confirmed, would fill the vacancy left by former CAB member Oswald Ryan whose term expired Dec. 31, and bring the Board to its full membership of five.

Prior to Rizley's nomination, the White House is understood to have offered the post to Harold Jones, a former CAB member, and Chief Justice Robert Simmons of the Nebraska Supreme Court. Opposition from local service airlines reportedly blocked Jones' appointment. Simmons is understood to have turned down the post because it would involve controversy due to conflicting laws: the 1938 Civil Aeronautics Act giving CAB autonomy, except in international decisions involving foreign policy, and the reorganization law creating an Undersecretary of Commerce for Transportation to direct air transportation policy.

Selection of a permanent CAB chairman still is to be made. Former chairman Chan Gurney is acting chairman.

Court Gives New Hope To Rails in Mail Case

Legality of the Post Office surface-mail-by-air program has been thrown into a state of confusion by a decision of Judge James R. Kirkland, U. S. District Court for the District of Columbia.

The decision is a break for the railroads, but it still leaves the final result in considerable doubt.

▶**Experiment Rights**—Judge Kirkland found that "the Postmaster General is acting beyond those limits of authority delegated to him by the Congress of the United States. . . ."

But he also found that the Postmaster General had the right to experiment as long as he did not let the mail test last too long. Kirkland said: "Prolonged experiments, which by the running of time demonstrate that the knowledge acquired by the experiment has been received and that it is a promulgation of an executive attempt to usurp the power of the legislative function, are unlawful."

The decision was handed down in a suit started last November by five western railroads in an attempt to stop the surface mail experiment on the West Coast. A petition for a temporary injunction was turned down earlier by the same court. The suit also asked the court to find the Postmaster General's action illegal and to stop the West Coast experiment by a permanent injunction.

▶**Not 'Prolonged'**—Kirkland decided that "prolonged experimental dispatch of first-class mail by air without congressional sanction is not a power granted to the Postmaster General of the United States. On the other hand, for the failure at this point of the plaintiffs to show irreparable injury, the motion for permanent injunction will be denied."

Since the West Coast program has been under way less than three months, the court did not judge it to be "prolonged." But the decision makes no measurement of what length of time makes such a program "prolonged" and thus leaves in considerable doubt the fate of the other parts of the experiment, some of which have been in operation nearly 18 months.

Presumably, the next steps will involve an appeal by the Postmaster General and further action by the railroads. In order to determine just how long an experiment can legally run, the eastern railroads will probably attack the most vulnerable program in length of time—the New York and Washington-Chicago segment.

▶**Legislation Possible**—Another question that remains to be cleared up is what the Postmaster General is trying to find out, and, thus, when is his information complete.

One thing that may eventually come out of the situation is an attempt to pass legislation to give the Postmaster General the powers he wants, or at least to clarify the situation.

In his opinion, Judge Kirkland observed that the American people may well be on the verge of a new classification of mail.

He said: "It may be that as we move ahead in the years ahead there will be a different classification and we will no longer speak of second class, third class, fourth class mail, but we will speak of high priority, deferred priority, medium service and slow service. . . ."

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Airlines Scrap for Mexico Nonstop

American, Eastern and PAA trade blows as they file new briefs supporting applications for lucrative route.

The three-way battle for nonstop New York-Mexico City service flared up again last week when American Airlines, Eastern Air Lines and Pan American World Airways filed briefs with Civil Aeronautics Board in support of their applications.

In a New York press conference, Eddie Rickenbacker, Eastern chairman, accused American and Pan Am of illegally trying to monopolize U. S.-Mexico routes and American of "attempting to rape the one route that still stands in the way—the New York-New Orleans-Mexico City service that Eastern has pioneered. . . ." The EAL brief asks the government to take legal action on the "record of violations of American and Pan American."

▶ **'Charitable' Explanation**—American filed a separate brief along with its regular brief devoted entirely to an analysis of Eastern's contentions and a number of counter accusations. The American brief holds that Eastern has forfeited any claim to an "equity" in the disputed service by its conduct.

"A charitable explanation," says American, "may be that Eastern was, in the words of its own counsel, Mr. Gambrell, 'hysterical' on the subject of Mexico. But hysteria is incompatible with the sound development of air transportation."

Pan American apparently has decided to leave the legal infighting to Eastern and American. The Pan Am brief sticks to the carrier's fitness and to reasons why it is the logical choice over its two competitors for the route.

▶ **Present Routes**—The case was instituted by CAB to certificate an American carrier to compete with Air France in the lucrative New York-Mexico City nonstop service. Currently, American operates one-stop service between the two points; Pan American flies from Mexico City to Texas, and Eastern flies Texas-New York. Eastern and Pan Am connect at Houston and Brownsville, Texas.

The situation is complicated by the fact that there is no bilateral agreement between Mexico and the United States, making it difficult to negotiate service into Mexico. Eastern was awarded a New Orleans-Mexico City route in 1946, but never could get it operating.

EAL takes the position that it should be certificated for the nonstop flights because it will furnish the best service and has the most direct route, and because, according to Eastern, both Pan Am and American are unfit to provide it.

▶ **'Feeble' Flight**—"Eastern's operation of the nonstop service in combination with its presently certificated direct route will result in superior development of the traffic between Mexico City and the entire Northeast and Southeast," says EAL. "Eastern is proposing far more adequate service than either American or Pan American has proposed.

"Eastern is the only applicant in this proceeding which proposes all-coach flights as well as all first-class flights between New York and Mexico City. American and Pan American propose only a feeble, combination coach-first-class flight which could not possibly meet the need for low-cost service to develop the tourist traffic between New York/Washington and Mexico City.

"Eastern is the only applicant which proposes fare savings to the public, as American and Pan American have geared their proposals simply to meet the standards set by Air France. Eastern proposes the greatest quantity and frequency of service—double the amount proposed by either American or Pan American. Eastern apparently is the only applicant which has confidence in the market and in its own ability to develop it."

▶ **Violation Claimed**—Eastern has asked for subpoenas for a number of witnesses and documents which it feels are vital to its case. Examiner Edward T. Stodola turned the request down, and the carrier is appealing it to the Board.

As for the fitness of American and Pan American, EAL says they have conducted themselves in direct violation of governmental directives for eight and a half years, "and have deliberately thrown confusion and chaos into bilateral negotiations in an effort, thus far successful, to defeat this government's efforts to implement Eastern's route. . . ."

The brief says: "Those carriers should not be rewarded for their unlawful and improper conduct" through the award of additional authorizations for Mexico City service.

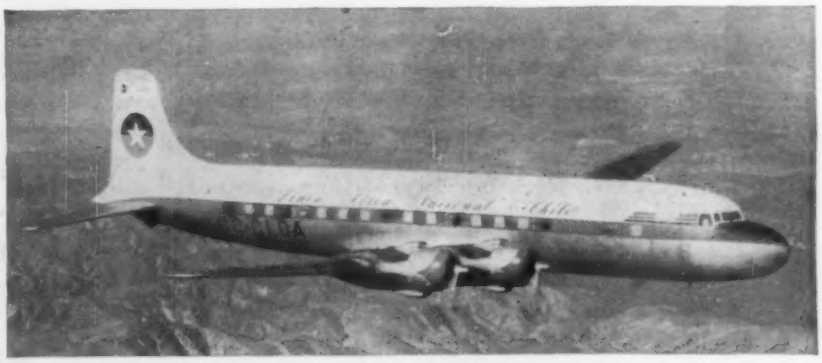
▶ **Improvement**—American argues in its brief it has pioneered the New York-Mexico City route and provided the only one-carrier, through-plane service for a dozen years. Granting of a nonstop authorization is viewed by American as a long-overdue improvement to a route it already possesses.

The AA brief also urges immediate approval of its application in order to provide competition with Air France. "Nonstop authority is thus necessary to enable American to compete on an equal basis for the market it pioneered and developed, as well as to permit improved modern nonstop service for New York-Washington-Mexico City traffic."

Pan American and Eastern should be turned down, according to American, because American should get the route and because there is not enough traffic for more than one U. S. carrier. The brief describes the New York-Mexico City passenger market as "a lean one at best."

▶ **Negotiations With Mexico**—In its separate brief dealing with Eastern's case, American denies Eastern's allegations and says EAL "blatantly disregarded the terms of such authorizations as it had to negotiate privately with the Mexican authorities and sought to make private arrangements contrary to this country's established policies and the national interest."

American says that Eastern went beyond its authorization and entered into an agreement with Mexico by which EAL would get a new route and a



Chilean Airline Studies Service to U.S.

Extension of its South American routes to California is being considered by Lineas Aerea Nacional, national airline of Chile. Here is the first of three Douglas DC-6B transports, delivered to the airline Jan. 27, that will be used on routes from Santiago to Buenos Aires and Montevideo; Santiago-Lima and Santiago-Magallanes beginning in March. Expansion would take the airline to Panama, Mexico City and California.

Mexican carrier would be authorized for Mexico City-New Orleans service.

American says that the agreement would:

- "Restrict this country's freedom to choose an air carrier (other than Eastern) to serve any route between the northeastern United States and Mexico."
- "Insure monopoly routes for Eastern and the Mexican carrier."
- "Make it virtually impossible for the United States to break these monopoly routes."
- "Guarantee Eastern further plums if by chance its monopoly routes were broken."

▶ **'Rumors, Needles'**—In reply to Eastern accusations that American obstructed and interfered with EAL efforts to get into Mexico, the American brief says that the most Eastern did in the hearings was to "have Capt. Rickenbacker refer to 'conversations, rumors, needles' that were given to me by people in the industry.

"Thus, Mosier (O. M. Mosier, AA vice president) simply laughed at us. And what does that prove? It may be assumed that Mr. Mosier laughed at Capt. Rickenbacker, and that on occasion Capt. Rickenbacker laughed at Mr. Mosier. Certainly if laughter constitutes 'obstruction' and 'interference', the airlines must become a grim and inhuman business."

▶ **Five Points**—In its brief to the Board, Pan American bases its argument on these five points:

- Nonstop New York-Mexico City service is required by public convenience and necessity, but Washington-Mexico City nonstop service is not required at this time.
- Only Pan American can provide all necessary service for both New York-Mexico City and Europe-Mexico City traffic.
- Pan American would make more net income from the route and is the only applicant which could use the money to reduce subsidy.
- Pan American certification would promote a balanced competitive air pattern between the U. S. and Mexico, while certification of American would entrench AA's monopoly of the service.
- The arguments presented by American and Eastern do not support their certification.

Pan American is particularly concerned with the fact that a large portion of the Mexico City traffic originates in Europe.

PAA figures that New York-Mexico City traffic produced about $5 million in revenue last year, while Europe-Mexico City traffic produced about the same amount.

Pan American claims that it would be better able to handle the New York-

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Mexico City service, since it could offer through service to Europe and compete with Air France on an equal basis. Also, the Mexican route would give Pan Am a weapon to use in obtaining a larger share of trans-Atlantic traffic for American-flag carriers, according to the PAA brief.

▶ **Acute Need**—Port of New York Authority, another interested party, also filed a brief in the controversial case last week.

Expressing no preference as to which U. S.-flag airline is awarded the route, PNYA attempted to show the acute need for nonstop service between the New York-New Jersey Port District and Mexico City.

Emphasizing the traffic potential now going to Air France, PNYA said New York is by far Mexico City's largest air travel market—citing an estimated potential of more than 45,000 passengers the U. S. airlines could be carrying annually.

Autopilots Cut Costs On American DC-7s

Installation of autopilots on American Airlines' entire DC-7 fleet would result in an estimated direct annual saving of $250,000. Subtracting $188,800 for amortization and maintenance costs, this would mean a net saving of more than $60,000 a year.

This was the analysis given by AA's M. G. Beard and Sperry Gyroscope Co.'s Percy Halpert at the recent national meeting of the Institute of the Aeronautical Sciences. It was based on evaluation of a number of DC-7 flights made with and without Sperry Gyroscope autopilots.

AA currently is in the midst of a program to equip all its DC-7s with autopilots. There is a possibility that this will be followed with a move to similarly equip all DC-6s and DC-6Bs. At present, 12 of the total fleet of 25 DC-7s have the units installed, with the remainder scheduled to go through the carrier's Tulsa maintenance base progressively.

▶ **Autopilot Tests**—The Beard-Halpert paper revealed that for tests, nine pairs of DC-7 flights were selected. Each pair of DC-7s flew under identical meteorological conditions, over the same routes, at similar altitudes and at maximum cruise power.

Overall comparison showed that the Sperry autopilot saved an average of 6.2 minutes per transcontinental nonstop trip.

It was pointed out that on shorter DC-7 runs, the saving would be less because of shorter cruise time. But assuming the average saving on the rest of the operation is half that of the transcontinental nonstop, the annual dollar

SEARCHLIGHT SECTION

saving, using direct operating costs, would be $250,000.

▶ **Overall Benefits**—The flights used in the comparison, Beard and Halpert said, had all the elements that go into actual operation of the fleet. The net result "should weigh heavily with the practical operator who thus far has been unable to obtain data on the automatic pilot saving in cruise flight."

It was emphasized that the main economic saving of autopilots actually is secondary to the overall greater benefits derived—such as improved safety and traffic conditions, passenger goodwill and increased public acceptance of airline travel. Also, there is the important advantage of lessening pilot fatigue.

CAB ORDERS

(Jan. 27-Feb. 2)

GRANTED:

National Airlines a temporary exemption to continue helicopter service in the Miami area until Mar. 1, 1955, to allow time for review of the renewal application.

Pan American World Airways and National Airlines leave to intervene in the Midet Aviation Corp.'s certificate renewal case.

American Airlines, Colonial Airlines, Delta-C&S Air Lines, Eastern Air Lines, National Airlines, Northeast Airlines, Pan American World Airways and United Air Lines leave to intervene in the Resort Airlines certificate renewal case.

APPROVED:

Certain resolutions adopted by International Air Transport Assn. at the traffic conference meetings at Venice, Italy, between various carriers relating to rate and traffic matters, subject to certain conditions, provisions and limitations.

Agreements involving American Airlines, Northeast Airlines and various other carriers relating to intercompany arrangements.

ORDERED:

Investigation of Braniff Airways' authorization to suspend service at Pueblo, Colo.

Investigation and suspension of certain reduced fares filed by Currey Air Transport, Ltd.

AMENDED:

Order of investigation and suspension of certain reduced fares filed by Great Lakes Airlines to include Pittsburgh, Pa.

DISMISSED:

Riddle Airlines petition for reconsideration of an earlier Board decision on a requested exception, since Riddle has asked that it be withdrawn.

Transocean Air Lines application for an exemption for certain Pacific services, since the application is now moot.

DENIED:

Flying Tiger Line application for an exemption to operate one flight between Munich, Germany, and New York.

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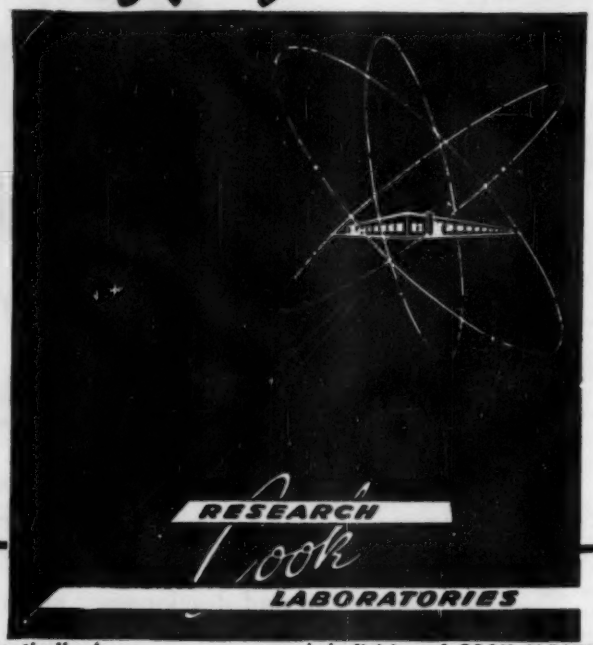

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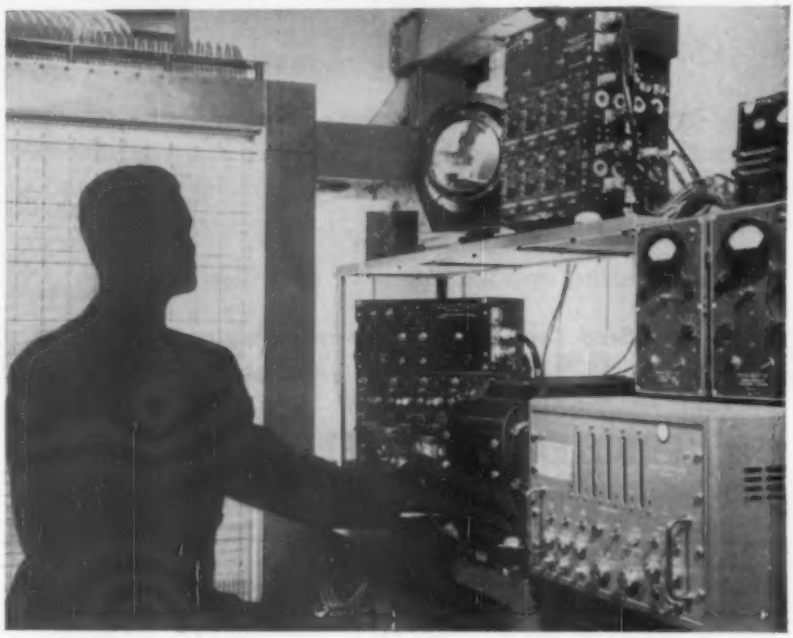

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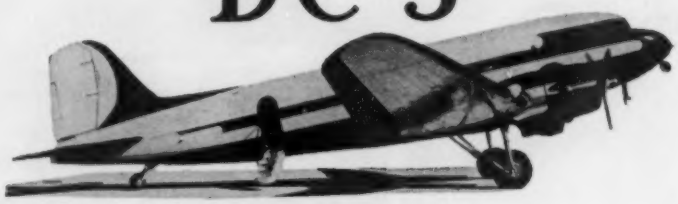

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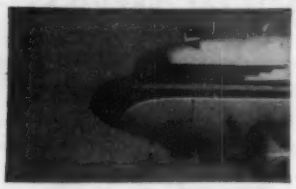

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Agency—D. P. Brother & Co.
ADEL PRECISION PRODUCTS DIV., GENERAL METALS CORP. 81
Agency—The McCarty Company
AEROJET-GENERAL CORPORATION 89
Agency—D'Arcy Adv. Company
AEROQUIP CORPORATION 86
Agency—The Fred M. Randall Company
AIRCRAFT MARINE PRODUCTS, INC. 104, 106
Agency—Reaner Corp.
AIRCRAFT RADIO CORPORATION 88
Agency—Burke Dowling Adams, Inc.
AMERICAN AIR FILTER CO., INC. (HERMAN-NELSON DIV.) 80
Agency—Kimmer-McClaskey Advertising
AMERICAN GYRO COMPANY 97
Agency—P. W. Voorhees Adv.
ARROWHEAD RUBBER COMPANY 99
Agency—Dan Ebbertz Adv. Service
AXELSON MFG. CO. 84
Agency—C. B. Juneau, Inc.
B. H. AIRCRAFT CO., INC. 80
Agency—Harold Marshall Adv. Co., Inc.
BARBER COLMAN CO. 73
Agency—Howard H. Monk & Assoc.
BASSICK COMPANY (A DIVISION OF STEWART WARNER CORP.) 86
Agency—James Thomas Chirurg Co.
BERNCO ENGINEERING CORP. 46
Agency—Rull Advertising Agency
BRIDGEPORT THERMOSTAT DIV., ROBERTSHAW-FULTON CONTROLS CO. 78
Agency—Arndt-Preston-Chapin-Lamb & Keen, Inc.
CANADAIR, LTD. 83
Agency—Walsh Advertising Co., Ltd.
CHANCE VOUGHT AIRCRAFT, INC. 74
Agency—Ruthrauff & Ryan, Inc.
CONSOLIDATED DIESEL ELECTRIC CORP. 82, 83
Agency—DeGarmo, Inc.
CONVAIR A DIVISION OF GENERAL DYNAMICS CORP. ..... Front Cover
Agency—Buchanan & Co., Inc.
DOW CORNING CORPORATION 49
Agency—Wagnitz Advertising, Inc.
ECLIPSE-PIONEER DIV., BENDIX AVIATION CORP. 64
Agency—MacManus, John & Adams, Inc.
EDISON, INC., THOMAS A. (INSTRUMENT DIV.) 102
Agency—Gaynor & Co., Inc.
EDO CORPORATION 46
Agency—Davis, Parsons & Strohmeier, Inc.
ELASTIC STOP NUT CORP. OF AMERICA ..... Fourth Cover
Agency—G. M. Basford Company
ELECTRO-AIRE, INC. 4
Agency—Ford C. McElligott & Assoc.
ENGINEERING & RESEARCH CORP. 24
Agency—Lewis Edwin Ryan
ESSO STANDARD OIL CO. 41
Agency—McCann-Erickson, Inc.
FLETCHER AVIATION CORPORATION 68, 90, 101
Agency—Hixson & Jorgensen, Inc.
GENERAL ELECTRIC COMPANY 65, 66, 67
Agency—G. M. Basford Company
GENERAL MILLS, INC. 61
Agency—Batten, Barton, Durstine & Osborn, Inc.
GILFILLAN BROTHERS 19
Agency—Erwin, Wasey & Co., Ltd.
GOODYEAR TIRE & RUBBER CO., INC. 25
Agency—Kudner Agency, Inc.
HARNISCHFEGER CORP. (WELDING DIVISION) .. 37
Agency—Hoffman & York, Inc.
HARTWELL AVIATION SUPPLY CO. 23
Agency—The McCarty Company
HETHERINGTON, INC. 82
Agency—The Harry P. Bridge Co.
HOLLEY CARBURETOR CO. ..... Second Cover
Agency—Holden-Chapin-Larue, Inc.
HUGHES RESEARCH & DEVELOPMENT LABORATORIES 101
Agency—Foote, Cone & Belding
INTERNATIONAL NICKEL CO., INC., THE 106
Agency—Marschalk & Pratt Co., Inc.
KIDDE & CO., INC., WALTER 3
Agency—Cunningham & Walsh, Inc.
KOLLSMAN INSTRUMENT CORP. 93
Agency—Schaefer & Favre Adv.
LABORATORY FOR ELECTRONICS, INC. 62, 63
Agency—Harold Cabot & Co., Inc.
LEWIS ENGINEERING COMPANY, THE 34
LINK AVIATION, INC. 35
Agency—Gaynor & Co., Inc.
LOCKHEED AIRCRAFT CORP. 76
Agency—Hal Stebbins, Inc.
LOCKHEED AIRCRAFT CORP. 111
Agency—Donahue & Coe, Inc.
LOUD MACHINE WORKS INC., H. M. 85
Agency—Walter C. Davison Company
MALLORY-SHARON TITANIUM CORPORATION .. 48
Agency—The Griswold-Eshleman Co.
MARTIN CO., THE GLENN L. 79
Agency—Vansant, Dugdale & Co., Inc.
McDONNELL AIRCRAFT CORPORATION 96
MICRO SWITCH DIV. OF MINNEAPOLIS-HONEYWELL REGULATOR CO. 91
Agency—Reincke, Meyer & Finn, Inc.
MONOGRAM MFG. CO., A DIV. OF LEWIS & KAUFMAN LTD. 8
Agency—Taggart & Young Adv.
NATIONAL WATER LIFT CO. 50
Agency—E. L. Erickson & Assoc., Inc.
NEW DEPARTURE DIV., GENERAL MOTORS CORP. 6
Agency—D. P. Brother & Co., Inc.
NORTHROP AIRCRAFT, INC. 34, 103
Agency—West-Marquis, Inc.
NORTH AMERICAN AVIATION, INC. 92
Agency—Batten, Barton, Durstine & Osborn, Inc.
OLIVER CORP. THE (AIRCRAFT DIV.) 33
Agency—Richard E. Putt Adv.
OSTER MFG. CO., JOHN 99
Agency—Burton Browne Adv.
PACIFIC DIV., BENDIX AVIATION CORP. 81
Agency—The Shaw Company Adv.
PERMACEL TAPE CORPORATION 42
Agency—The Aitkin-Kynett Co. Adv.
PHILLIPS PETROLEUM CO. 5
Agency—Lambert & Feasley, Inc.
PSP ENGINEERING CO. 21
Agency—J. J. Swain Advertising
RAMO-WOOLDRIDGE CORP. 89
Agency—The McCarty Company
REM-CRU TITANIUM, INC. 10
Agency—G. M. Basford Co.
RHEEM MFG. COMPANY, GOVT. PRODUCTS DIV. 20
Agency—Campbell-Ewald Co.
ROBINSON CO., RALPH C. 21
Agency—Chapin-Damm Adv.
RODNEY METALS, INC. 60
Agency—Germain-Wertheim Advertising
ROLLE MANUFACTURING COMPANY 43
Agency—The Harry P. Bridge Co.
ROTOL LIMITED 87
Agency—Gaynor & Co., Inc.
RYERSON & SON, INC., JOSEPH T. 92
Agency—Aubrey, Finlay, Morley & Hodgson, Inc.
SAGINAW STEERING GEAR DIV., GENERAL MOTORS CORP. 30, 31
Agency—D. P. Brother & Co.
SANBORN COMPANY 38
Agency—Meissner & Culver Corp.
SCINTILLA MAGNETO DIV., BENDIX AVIATION CORP. 28
Agency—MacManus, John & Adams, Inc.
SEARCHLIGHT SECTION 113, 114, 115, 116, 117, 118, 119, 120
SENSENICH CORP. 92
Agency—Foltz-Wessinger, Inc.
SHELL CHEMICAL CORPORATION 47
Agency—J. Walter Thompson Co.
SKYLINE PRODUCTS, INC. 121
Agency—Triton Advertising
SPERRY GYROSCOPE CO., DIV. THE SPERRY CORP. ..... Third Cover
Agency—Reach, Yates & Mattoon, Inc.
STEWART WARNER CORP. (STEWART WARNER ELEC. DIV.) 71
Agency—O'Grady-Anderson-Gray, Inc.
SUMMERS GYROSCOPE COMPANY 21
Agency—Byron H. Brown & Staff
TEMCO AIRCRAFT CORP. 22
Agency—Taylor-Norsworthy, Inc.
TRENT TUBE COMPANY 84
Agency—G. M. Basford Co.
TWIGG INDUSTRIES, INC. 44, 45
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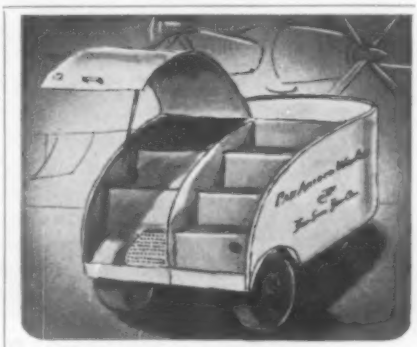

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EDITORIAL

Twin Spotlights on Naval Aviation

Twin spotlights of public attention are now focused on naval aviation—off Formosa where the four big attack carriers of the 7th Fleet are holding the line against Chinese Communism and on Capitol Hill in Washington where a congressional subcommittee is investigating the reasons for the Navy's lagging procurement of modern combat aircraft.

The fact that development and production of modern transonic jet-powered aircraft for the Navy has been slow is apparent in the equipment of air groups aboard the 7th Fleet carriers. Once again the amount of time it takes to translate congressional appropriations into combat ready airpower is heavily underscored in an hour of crisis.

The billions appropriated for the production of naval aircraft after the outbreak of the Korean war in 1950 have not yet reached the firing line in the form of enough modern jet aircraft to be of military significance.

None in Battle Line

Public prints have been full of the record-breaking capabilities of the latest crop of Navy's transonic fighters —the Douglas F4D Skyray, the Grumman F9F-9 Tiger, and the North American FJ-3 and FJ-4 Furies. All of these aircraft are flying and some of them have been in the air for as long as two years. Yet none of them is with the 7th Fleet on the battle line off Formosa. Fighter squadrons aboard the carriers Kearsarge, Essex, Wasp and the giant Midway are equipped with straight-winged Grumman F9F-5 Panthers and McDonnell F2H Banshees, both with speed limitations well below the current standard for modern air-to-air combat. Some fighter squadrons with the 7th Fleet also have Grumman F9F-6 sweptwing Cougars, a more modern fighter edging into the transonic range but still with performance well below the F9F-8 now in production at Grumman's Bethpage, L.I., plant and the F9F-9, still in experimental flight test stage.

In the bomber category the Navy has two fine Douglas designs, the sweptwing A3D Skywarrior and the A4D lightweight delta, already in production. But again these planes are not on the firing line in Formosa. First A3D carrier squadron has been organized, but the A4D still is in experimental testing. The bombers with the 7th Fleet are the old veterans of the Korean war—the piston-powered Douglas Skyraider. In its atomic bomber units stationed in Japan, but available for operations off 7th Fleet carriers, are the North American AJ-2s, powered by a pair of piston engines with a jet for extra boost.

Although equipment is only one part of the air combat equation that includes pilot proficiency, tactics and leadership, it would take an extreme optimist to be happy about the quality of the aircraft the 7th Fleet has to fight against the sweptwing MiG-15 fighters and the twin-jet IL-28 bombers that are operational in sizable quantities with the Chinese Communist Air Force.

There is little doubt that in these other items—pilot proficiency, tactics and combat leadership—the 7th Fleet has quality far superior to its potential foe. Aircraft industry leaders, who remember Vice Adm. Alfred M. "Mel" Pride for his technical pioneering with early carrier aircraft and his tenure as chief of the Bureau of Aeronautics, will agree that the Navy could find no better commander for what is now its most important battle force afloat. In addition to his wartime record as an aircraft carrier commander in the Pacific he knows so well, Adm. Pride made important contributions to the development of carrier arresting gear, and on the autogiros from which developed Navy's present use of helicopters. For years he fought almost single-handedly to keep turboprop development alive in this country.

BuAer's Persistence

The fact that the Air Force will be able to build a fleet of turboprop-powered transports to equip its aerial logistics system of the future is due in large measure to the Navy Bureau of Aeronautics' persistence, led by Adm. Pride, in pushing development of this type engine despite what looked to many as insurmountable obstacles only a few years ago.

We do not think the subcommittee of the House Armed Services Committee will accomplish much by raking up the details of the technical troubles of the Navy's aircraft development during the past five years. The details are well known in the aircraft industry and in the Navy, and investigations will not resurrect the once promising projects that might have filled the interim gap in the Navy's aerial battle force.

Fundamental to this problem was the starvation diet of naval aircraft research and development funds in the pre-Korean era that prevented a more vigorous attack on the technical problems of the jet age.

Research Is Key

There are many promising new technical avenues along which naval aviation is moving toward its future—the vertical takeoff and landing fighters; the water-borne aircraft, ranging from the giant jet seaplane teamed with submarine tankers to the supersonic delta fighters equipped with hydroskis for landing on water, snow, ice or tundra, and the lightweight design philosophy that can pay a double dividend in increased combat strength for less money.

We recommend to the House Armed Services Committee and their colleagues in the Senate that instead of poking around in the ashes of the past they bend their efforts to making certain that naval aviation gets the research, development and procurement funds necessary to push its promising new developments as hard and fast as possible in a concerted effort to avoid the qualitative inferiority that will threaten its aerial battle line if the new ideas are again allowed to drag and wither for lack of sufficient support.

—Robert Hotz

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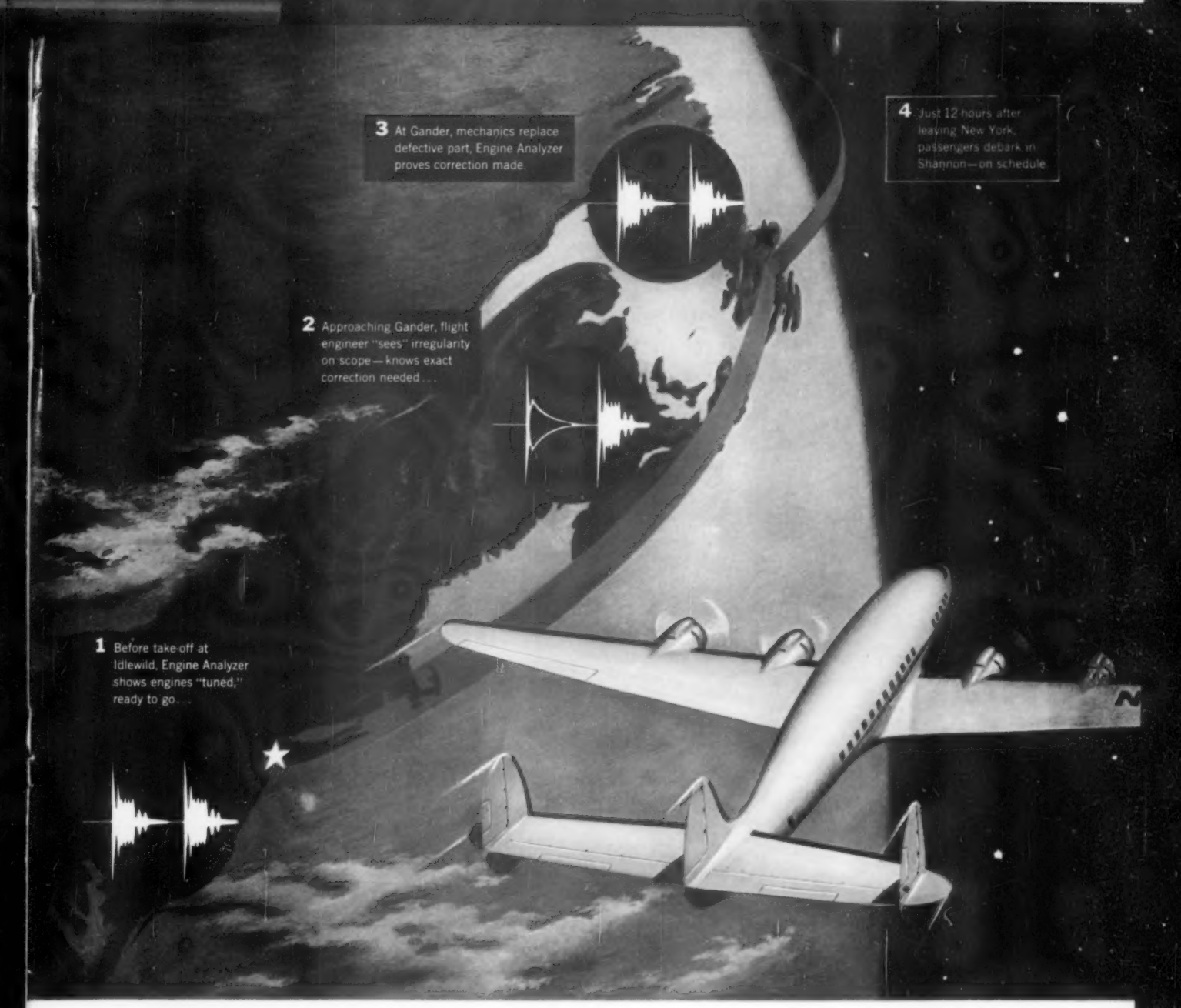
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